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LECTURES.

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Lieutenant-General W. F. KNOLLYS, Vice-President of the Council of Education, in the Chair.

THE ITALIAN CAMPAIGN OF 1859.

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PART I. GENERAL ACCOUNT.

Their oaths are said,
Their prayers are prayed,
Their lances in the rest are laid,
They meet in mortal shock.—MARMION.

THE Italian Campaign of 1859 presents two or three points of such peculiar interest that I am surprised at our not having any good work upon it in our own language—such a work as would describe minutely the incidents in its history, and set clearly before us the effects of certain mechanical agencies which were then for the first time brought into serious military use.

In this campaign, railways assisted the ordinary means of locomotion hitherto employed by armies. By them, thousands of men were carried daily through France to Toulon, Marseilles, or the foot of Mont Cenis; by them, troops were hastened up to the very fields of battle; and by them, injured men were brought swiftly back to the hospitals, still groaning in the first agony of their wounds.

Moreover, the railway cuttings, embankments, and bridges presented features of importance equal, or superior, to the ordinary accidents of ground; and the possession of such features was hotly contested. If you go to Magenta, you will see, close to the railway platform on which you alight, an excavation full of rough mounds and simple black crosses, erected to mark the resting-places of many hundred men who fell in the

great fight. This first employment of railways in close connection with vast military operations would alone be enough to give a distinction to this campaign in military history—but the incident does not stand alone.

Rifled cannon also made their essay in serious warfare, and all the world looked with curiosity to see what effect would be produced on the hostile ranks by the French field-guns, which were reported to hit with certainty a man on horseback more than a mile off.

Further, the forces engaged were those of a magnificent military nation, allied with a very perfectly organised though not large army, arrayed against an empire apparently quite able to defend itself against both together; and finally, to add dignity to the struggle, the armies were commanded by their own sovereigns, and two emperors and a king shared with their troops the dangers and difficulties of the campaign.

I think then that such a campaign ought to be carefully studied, and deserves to be skilfully and closely described; but no such description, in English, have we got. Articles and translations have, indeed, appeared in reviews, magazines, and journals; but of histories, properly so called, none. Only the absence (so far as I know) of any such work would have induced me to make my first essay in public speaking by addressing so cultivated, so critical, and consequently so formidable, an audience as that which assembles at the Royal United Service Institution.

As the subject is unavoidably divided into two parts, I shall confine myself to-day to describing the events of the campaign as they occurred, and shall reserve all criticism, and all inquiry into the causes which produced those results, for the lecture which I am to give here on this day fortnight. Each lecture will then be complete in itself, and I hope that the two together will convey a clear idea of this interesting campaign.

I have no doubt you all recollect how the first hint of a war was given by Louis Napoleon, at the Tuileries, on New Year's Day; how negotiations went on till the 26th April; how the Austrians presented an ultimatum which was rejected; and how, on the 29th, they began to cross the Ticino, that river being then their frontier line; but you are not perhaps aware that this irruption into Piedmontese territory was preceded by one on the French part, which was equally, I suppose, an infringement of existing treaties. The Austrians crossed into Piedmont on the 29th April, the French advanced into Savoy on the 25th, and on the following day there were 4,000 or 5,000 men in the neighbourhood of St. Jean de Maurienne, ready to begin the passage of Mont Cenis. The fact was, that Louis Napoleon well knew that war must come before this movement was generally known; equally well knew that all the celerity in his power would not throw his army into Italy before the Sardinians were in the grasp of their enemies; and he judged it desirable to gain time in any possible manner.

The army with which Louis Napoleon proposed to free Italy from the Alps to the Adriatic (as he expressed it) was composed of six *corps-d'armée*, and contained about 160,000 infantry, 20,000 cavalry, and 354 field-guns: we may estimate the whole as 190,000 combatant men. General d'Angely commanded the Imperial Guard, which formed a corps complete in itself; Count Baraguay d'Hilliers, who was made a marshal for the capture of Bomarsund in 1854, commanded the first corps; Count M'Mahon, the second; Marshal Canrobert, formerly commander-in-chief in the Crimea,

the third; General Niel, the fourth; and Prince Napoleon, the fifth. I may as well mention at once, that the last corps, the fifth, had little or no share in the operations of the war. The greater part was sent into Tuscany, partly for military, but principally for political, purposes. Some of its regiments were present at Montebello; and one of them, the third Zouaves, highly distinguished itself at Palestro; but the corps in its complete state did not join the main body till after the battle of Solferino.

The first, second, and fifth corps and Imperial Guard were conveyed to Italy by sea, and landed at Genoa; some of the regiments were conveyed from Paris by that route in the short space of five days. The two remaining corps crossed the Mont Cenis. By this route, a line of railway carried them to St. Jean de Maurienne; and another line took them to Susa, on the Italian side of the pass, 37 miles from Turin. Between these two places, about 40 miles apart, the march had to be performed on foot over a mountain pass not yet clear of the winter snow. As a specimen of the vigour with which it was carried out, I may mention that the cavalry, artillery, and even some of the infantry, are said to have done it in one day's march, although the *diligence* takes fourteen hours for the journey.

The Sardinian army (it is more often called the Piedmontese army by continental writers), a combatant force of 63,000 infantry, 5,000 cavalry, and 120 guns, amounting to about 70,000 men, and divided into five divisions, occupied, when the war began, a line of 70 miles' extent, stretching from Ivrea to Alessandria. They were thus placed to oppose any attack upon their capital, Turin. Their small force, small in comparison with that of the Austrians, who had already invaded the country, was supported by permanent fortifications at Alessandria and Casale, field-works at every important point, and the naturally strong features of their line of defence.

Of these features the river Po is by far the most important. At Valenza it is 550 yards across (as wide as the Thames at Woolwich) with only two regular bridges (of masonry) in the neighbourhood, one at Valenza, the other at Casale; of boat-bridges there were several, but these had of course been removed. Preparations were made for blowing up the stone bridges, if necessary, but it was not desirable to do so until the last extremity, because the Allies might, after a while, require them for the passage of their own troops.

On the further side of the Casale bridge, which, until the introduction of railways a few years since, was the only masonry bridge below Turin, there was a strong *tête-de-pont*, and this fortification had an important effect on the ulterior movements, for it secured to the Allies the means of safely crossing the river. The Valenza bridge, having no such defence, was blown up by the Austrians when they had given up the idea of using it themselves.

The Sardinians, I said, took up a line from Ivrea to Alessandria, following the course of the Dora Baltea and the Po. As the Dora Baltea river was insufficient to secure that part of the line from being attacked, and only 25,000 men could be spared to watch a front of 20 miles, the French generals advised that its defence should be given up, and that the whole force should be concentrated about Alessandria and Casale. This was done, and only a few squadrons of cavalry remained between the defenceless capital and the invading Austrians. Imagine a foreign army safely landed

at Harwich, at Sheerness, or at Brighton, with only the Life Guards to defend London, and you will understand the critical position of Turin.

The Austrians were about 150,000 strong. The full strength of the six *corps-d'armée* which composed their army in Italy would be more than 200,000; but many distant garrisons and detached bodies of men had to be furnished, and their moveable strength did not exceed 24 brigades, containing about 6,000 each: Feldzeugmeister Count Gyulai commanded the whole.

At any rate the Austrians were double the number of the Sardinians; and all Europe watched the scene of action, curious to see in which of the different modes suggested by military writers the important blow would be struck. It was not struck at all. Only demonstrations were made, which might mean anything, and which resulted in nothing. That is to say, on one side of the Po the Austrian main body advanced as far as St. Germano, on the 9th May, and then returned to the Sesia. On the other side a column penetrated to Tortona, but returned on the sixth, after destroying the railway bridge at Ponte Curone near Voghera. Finally, on the 19th May, Gyulai gave up Vercelli, blew up the bridge, and took up a definite position behind the Sesia and Po, from Robbio to Pavia, in which he intended to receive, and expected to defeat, any attack which the Allies might make.

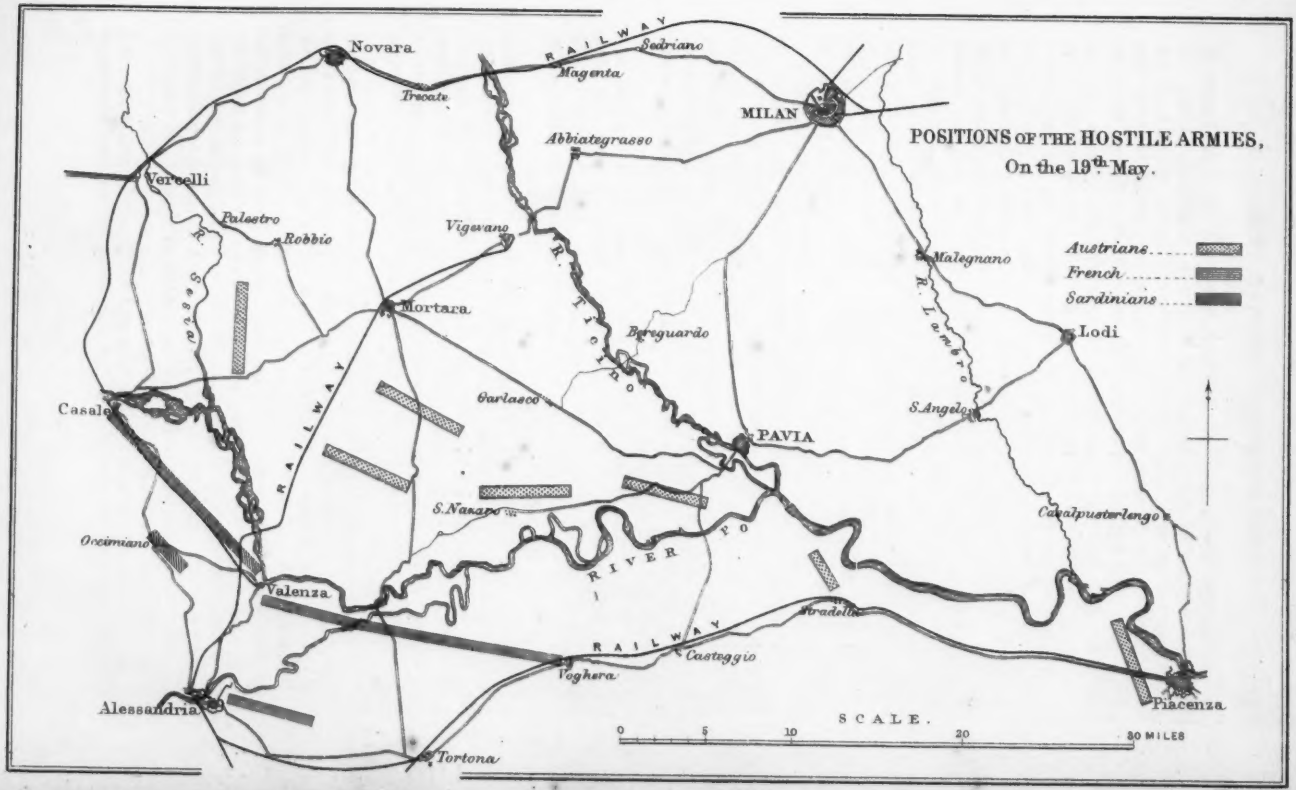
As yet, however, the Allies were not ready to attack. In spite of all exertions, the French cavalry and artillery could not be transported to the frontier quick enough to keep pace with the infantry, which went to the front as rapidly as possible to strengthen the Sardinians there. Moreover, the infantry were not complete in numbers, for many men, a large proportion of men, absent on permanent leave (*congé renouvelable*) when the war began, had not rejoined the ranks.

With an incomplete army, of course the Allies could undertake nothing; but the information which Gyulai received led him to suppose that they already meditated an attempt upon his left, or centre; and, to obtain confirmation of the report, he ordered that reconnaissance to be made which resulted in the battle of Montebello.

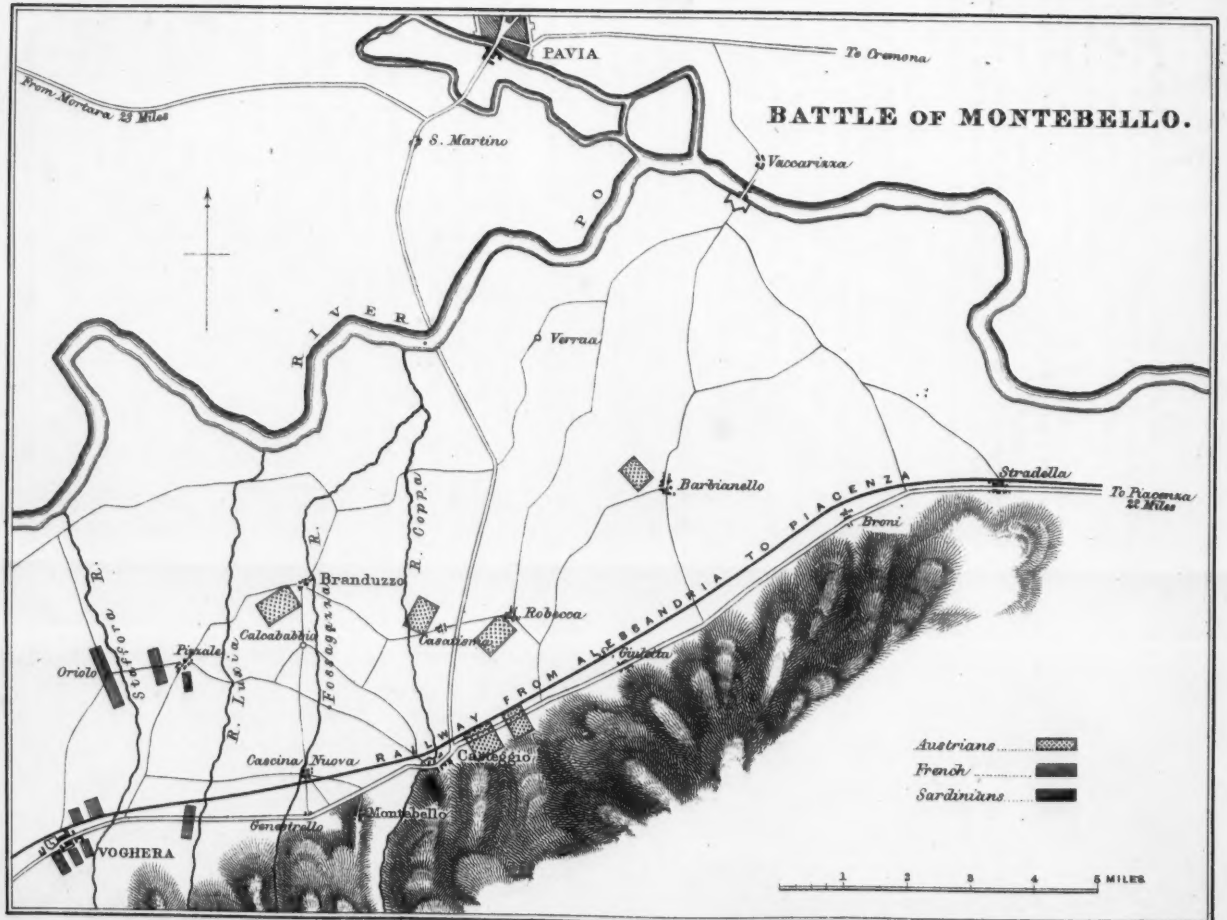
Brigades were taken from different corps for this service, and put under the command of General Count Stadion. Their total strength is estimated by various authors at various numbers; but they contained at least 18 battalions, and probably 18,000 men. Count Stadion's instructions were, to threaten Voghera in such a manner that the whole of the allied forces in that neighbourhood might be brought to display themselves. He executed the orders thus.

Count Urban, with seven battalions, was to proceed along the main road from Stradella towards Casteggio. The other battalions would cross the Po by a military bridge at Vaccarizza, and then, diverging from one another, march on the following points: three battalions under the Prince of Hesse to Branduzzo (these formed the extreme right), three battalions under Gaal to Robecco, and three under Bils, to Casatisma; these six battalions formed the centre, and the seven with Count Urban, before mentioned, formed the left. A reserve of two battalions was directed on Barbianello. All these bodies of men were to reach their intended positions by noon, and then to advance simultaneously on Voghera.

The nearest of the allied troops belonged to the 1st French corps, and the most advanced division (Forey's) of this corps had its head-quarters at


POSITIONS OF THE HOSTILE ARMIES,
On the 19th May.
Austrians
French
Sardinians
Novara
Trecate
Sedriano
Magenta
MILAN
Abbiategrasso
Vercelli
Palestro
Robbio
Vigevano
Malegnano
Lodi
Mortara
Bereguardo
Casale
Garlasco
S. Angelo
PAVIA
S. Nazaro
Occimiano
Valenza
Voghera
Casteggio
Alessandria
Tortona
Piacenza
Cavalpusterlengo
Stradella
RAILWAY
RIVER PO
R. TICINO
R. LAMBRO
SCALE.
0 5 10 20 30 MILES

J.R.Jobbins.


BATTLE OF MONTEBELLO.
PAVIA
To Cremona
From Mortara 23 Miles
S. Martino
Vaccarizza
P O
R I V E R
Verrua
Barbianello
Stradella
To Piacenza 22 Miles
Broni
Branduzzo
R. Coppa
R.
Robecca
Calcababbia
Casatisma
Pizzale
Oriolo
Stradone
R. Lavia
Fossagazza
Giuseta
RAILWAY FROM ALESSANDRIA TO PIACENZA
Cascina Nuova
Montebello
Genestrello
VOGHERA
Austrians
French
Sardinians
1 2 3 4 5 MILES

J.R.Jobbins

Voghera, with four battalions thrown out to Oriolo on the left, and two in front of those four at Pizzale; also there were two battalions on the Luxia stream, a couple of miles east of Voghera; more easterly still, at Casteggio, were eight squadrons of Piedmontese cavalry.

These squadrons did all that cavalry could do to check the approaching Austrian columns between Casteggio and the Luxia, until the French were prepared for action. They charged gallantly again and again, and had their ranks terribly thinned at each successive charge; but they did not suffer in vain; the advance was retarded, and when the Austrians reached Genestrello, half way between Casteggio and the Luxia stream, the French were fast arriving.

Forey, who commanded the division to which they belonged, was not the man to display his forces and wait idly whilst Stadion leisurely counted them. With a boldness, or perhaps more than boldness, a rashness only justified by success, he left one sole battalion to hold the farm buildings of Cascina Nuova against three times its number, and employed the first reinforcements to aid himself in attacking the Austrians at Genestrello. He drove them back to Montebello, and then there was a pause; Stadion brought in Gaal's brigade to assist the discomfited troops of Urban's division, and Forey formed up all but one of his battalions for an attack of the village.

Between four and five the fighting began again. During two hours a hot struggle was maintained; then Stadion, finding that he lost ground bit by bit, and that houses were taken from him one by one, made a second retreat to Casteggio, and brought the brigades of Bils and Hesse to join the rest there. Forey was not strong enough to attempt more; it was late before the troops which joined him were ready to take an active part, and so Stadion was no further molested. During the night the Austrians fell back quietly on Vaccarizza.

Hesse's brigade had a slight engagement at Oriolo, whilst the rest fought at Genestrello and Montebello, but it was unimportant in its extent or in its result. The heat of the action was confined to a short distance on either side of the main road, and came to its climax in the contest for the village of Montebello.

Unfortunately for the confidence of the Austrian soldiers, they were not well handled at this their first contact with the enemy; and yet, if Gyulai's orders were carried out, the force which executed them must have been placed in a false position, more or less dangerous according to the advantage which the enemy might take of its weakness. As, however, I cannot stop for criticism in this lecture, I will only remark now in what a cold, heartless manner Gyulai's despatch refers to the loss entailed by this reconnaissance—losses amounting to 294 dead and 718 wounded, besides 283 missing. I will give you Gyulai's own words, in which he sums up the events of the day: "Lt. Field-Marshal Stadion estimates the number of the enemy at 40,000 men at least. I consider, then, that the conclusion which is drawn from the reconnaissance in question, and which confirms the excellence of the position I occupy, as a precious result, which has not been too dearly bought, notwithstanding the losses it has cost us." This is not in his first despatch, but in another one written on the 23rd of May, when he had had time to consider the affair calmly. And this is the way in which he accounts for the soldiers committed to his charge; this is his idea of the

value of human life. He considers that it is worth while to sacrifice the lives and limbs of 1,000 men to ascertain that the enemy are 40,000 strong near a certain place. I am tempted to borrow his own expression, as Gratiano does that of Shylock, and to say "a precious result" indeed. Moreover, Stadion's estimate was as wrong as Gyulai's principle of economy was bad. Forey had only about 4,000 men engaged; and, if the whole of the first corps was displayed during the day, its numbers did not then amount to 25,000 men.

Three weeks had now passed since hostilities began; Louis Napoleon had assumed the command in chief; he had had time to consider his plans, and his army was rapidly becoming sufficiently complete in its equipment to carry them into execution.

The further he could penetrate into Lombardy, with due regard to his base of operations, the more he would embarrass the Austrians, because the population was in his favour; but he could not expect they would abandon the country without fighting a battle, and the most he could at present hope was to gain a position from which he could fight on equal terms.

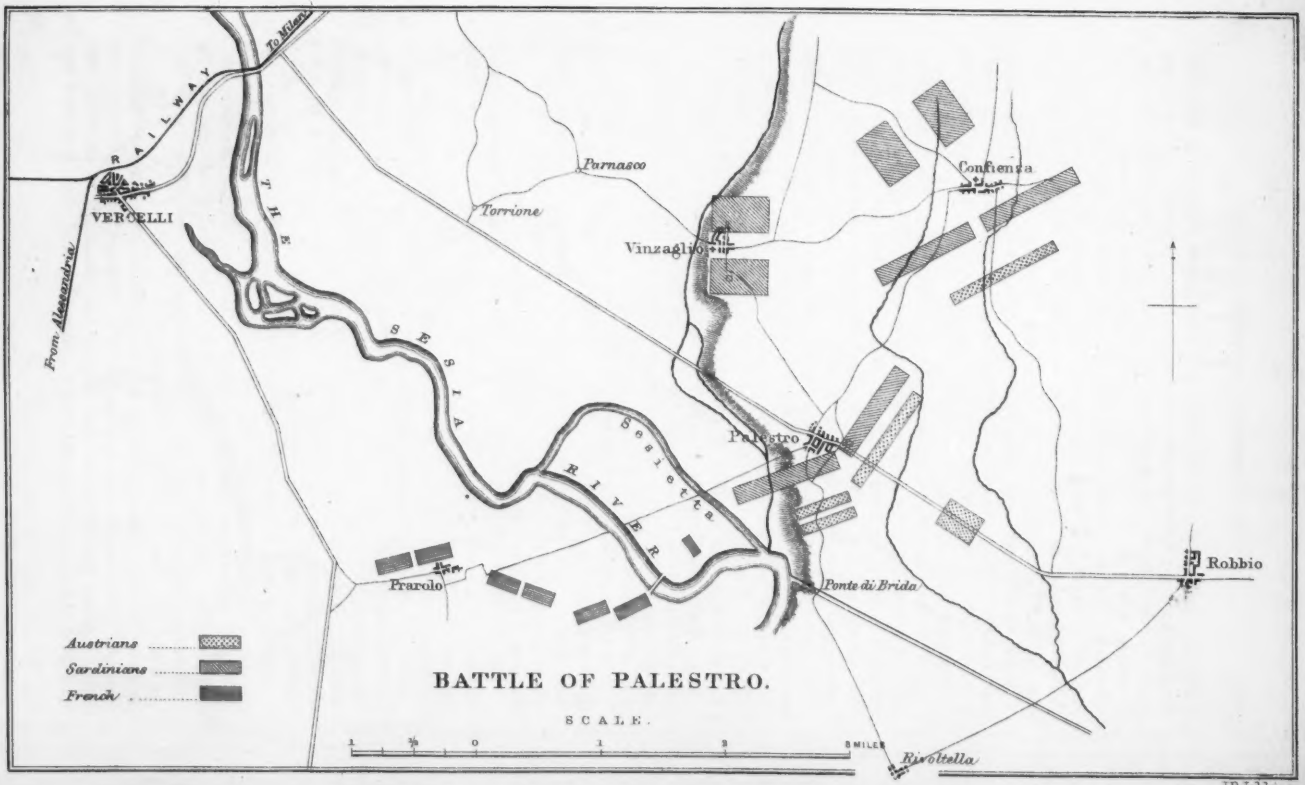
To cross the Po, with the Austrians in strength on the opposite side, was almost impracticable; if he went easterly he came under the guns of Piacenza; if he went westerly he had certainly a bridge over the Po at Casale, but the Sesia still remained between him and the enemy, and presented a formidable obstacle, if its passage were opposed. If, however, it had no enemy on its banks, it would be nothing, therefore Louis Napoleon proceeded to draw Gyulai's attention to the Po, near Voghera, whilst he secretly prepared to throw the whole allied army across the Sesia at Vercelli, and to push it on thence to Novara.

From Vercelli to Novara there is an excellent road, but the enemy's outposts were strong, and close to its south side. These outposts it was desirable to drive back, and the execution of this was committed to the Piedmontese, with Canrobert's *corps d'armée* to support them. It led to the two days' fighting, called the battle of Palestro.

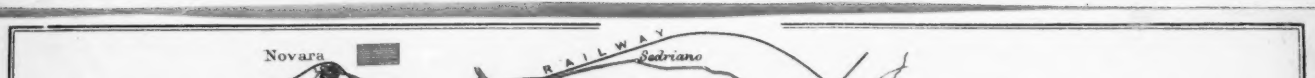
On the 29th May four of the Piedmontese divisions were concentrated at Vercelli; the bridge there, which the Austrians had partly destroyed, was repaired, and the divisions crossed on the 30th. They proceeded to take possession of the villages Palestro, Vinzaglio, and Confienza, which the Austrian outposts occupied; and, having an overwhelming superiority in numbers, they did so after some sharp fighting; Canrobert in the meantime was constructing pontoon bridges over the Sesia at Prarolo, nearly opposite Palestro. It was intended that the forces should unite and move on together towards Robbio next morning, but this plan was forestalled by their receiving a counter attack in their own position.

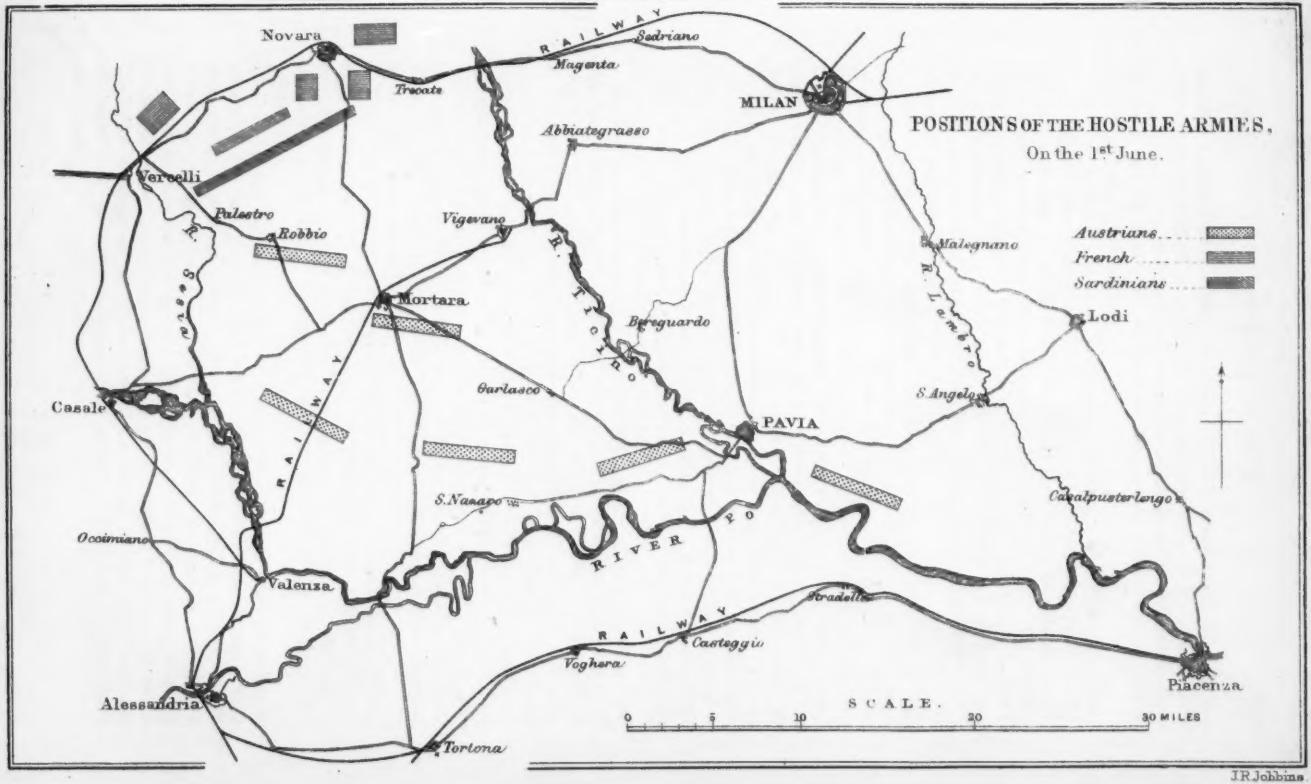
The Austrians, repulsed on the 30th, belonged to Lilia's division of the seventh (Zobel's) corps, and this division, assisted by Jellachich's division of the second corps, came to retake the lost ground. There were four brigades: one formed a reserve, one attempted to carry Confienza, and the other two advanced on Palestro, attacking it simultaneously from the Robbio road and from the south side of the village.

But what could these four brigades do against four Piedmontese divisions backed by a whole French *corps d'armée*? The odds were 18,000 Austrians against 65,000 Allies, and of these 18,000 one-half was weakened and dispirited by the defeat of the previous day, and the other half had


To Milan
RAILWAY
From Alessandria
VERCELLI
THE
SESIA
Parnasco
Torrione
Vinzaglio
Confienza
Palestro
Sesietta
RIVER
Prarolo
Ponte di Brida
Robbio
Rivoltella
Austrians
Sardinians
French
BATTLE OF PALESTRO.
SCALE.
1 ½ 0 1 2 3 MILES

J.R.Jobbins.


Novara
RAILWAY
Sedriano


POSITIONS OF THE HOSTILE ARMIES,
On the 1st June.
Austrians
French
Sardinians
Novara
Trecate
Magenta
Sedriano
MILAN
Abbiategrasso
Vercelli
Palestro
Robbio
Vigevano
Mortara
Malegnano
Lodi
Bereguardo
Garlasco
S. Angelo
Casale
PAVIA
S. Nazaro
Calcalpusterlengo
Ocoimiano
Valenza
Voghera
Castegg'o
Stradella
Piacenza
Alessandria
Tortona
RAILWAY
R. TICINO
R. LAMBRO
RIVER PO
SCALE.
0
5
10
20
30 MILES

J.R.Jobbins

marched 15 miles to the scene of action. It is a wonder that they effected their retreat to Robbio so easily as they did, and only to be satisfactorily accounted for by a statement that the allied generals had orders not to show too much of their strength, lest the Austrians should suspect the real object of their presence in that quarter.

Yet the Austrian attack on Palestro was dashing, and obtained some success. Here it was that King Victor Emmanuel earned his reputation for personal gallantry, and here it was that the third Zouaves made such a brilliant charge upon the Austrian riflemen and artillery. They unexpectedly forded a stream called the Sesietta, and so came upon the enemy in flank, just at the passage of a canal which impeded any retreat; so complete was their success that the riflemen lost 500 men (one-half their number), and a battery of artillery had to abandon all its guns.

Two more days the Sardinians and Canrobert's corps remained on this side of the road to Milan, whilst the other French corps were moved round by road and rail from Voghera to Novara, a distance of 70 miles. By the 2nd June the concentration of the Allies at that town was completed, and Louis Napoleon quite expected that the Austrians, perceiving what he was about, would come to attack him there. Zobel had, indeed, recommended Gyulai to make an attack, for he had become aware that the engagement at Palestro was no feint, but a real indication of an important move. Gyulai would not, however, change the position of his troops. Louis Napoleon therefore prepared for a further advance, and with that object ordered a bridge to be constructed over the Ticino at Turbigo, a few miles above the Milan road, whilst a reconnoitring column went to San Martino to ascertain the state of things in the immediate front.

At San Martino the road and the railway are carried over the river by a new stone bridge, for the defence of which the Austrians had previously prepared a field-work; but this field-work was found deserted, and seemed to have been deserted very hurriedly, for four pieces of ordnance and other *matériel* were found in it, and a mine which had been fired to destroy the bridge had failed to bring down a single arch. This was a most important circumstance, for the Allies had now two places at which they could cross the river unopposed, whilst there was only one *corps d'armée* immediately between them and Milan. This was the first corps, commanded by Count Clam Gallas; it was just arrived from Bohemia, and was not yet complete in numbers or equipment.

With one division of this corps M'Mahon had an encounter near Turbigo on the afternoon of the 3rd June, but it was of little importance, and only interesting because it shows how ignorant the Austrians were, up to this time, of the Allies' movements, and how little suspicious of their real intentions.

The division had been sent to watch the Ticino at Turbigo—sent to watch it just one day too late. Twenty-four hours sooner it could have prevented, or seriously delayed, the operation. Coming up when it did, it found the bridge finished, and the enemy already in superior numbers on the eastern side of the river. This incident tended to show that the Austrians were not in force near Magenta. Louis Napoleon therefore fixed the crossing of the Ticino for the morning of the 4th June, and arranged such an order of battle as he judged fit for the opposition likely to be met.

In the meantime, however, a change in the Austrian position had brought more troops into the neighbourhood of Magenta than any reconnaissance of the Allies could possibly detect.

Gyulai had at last perceived the necessity of leaving the defensive line he had occupied so long. On the night of the 2nd June three corps crossed the Ticino at Vigevano, and two at Bereguardo, and all were marching towards Magenta and Milan, when a mysterious interview took place between Gyulai and Count Hess, the Emperor's military adviser. Immediately afterwards all these corps were ordered to stop, and Gyulai's defenders maintain that this, an unwarranted interference on the part of Hess, caused the loss of the battle which ensued. The fact of the interview was as stoutly denied by some as it was strongly asserted by others. I have it on the authority of an Austrian staff officer that the interview did take place and the orders were issued as above described; and certainly they had some influence on the events which succeeded; but that they caused the loss of the battle I cannot admit, for reasons which will appear hereafter.

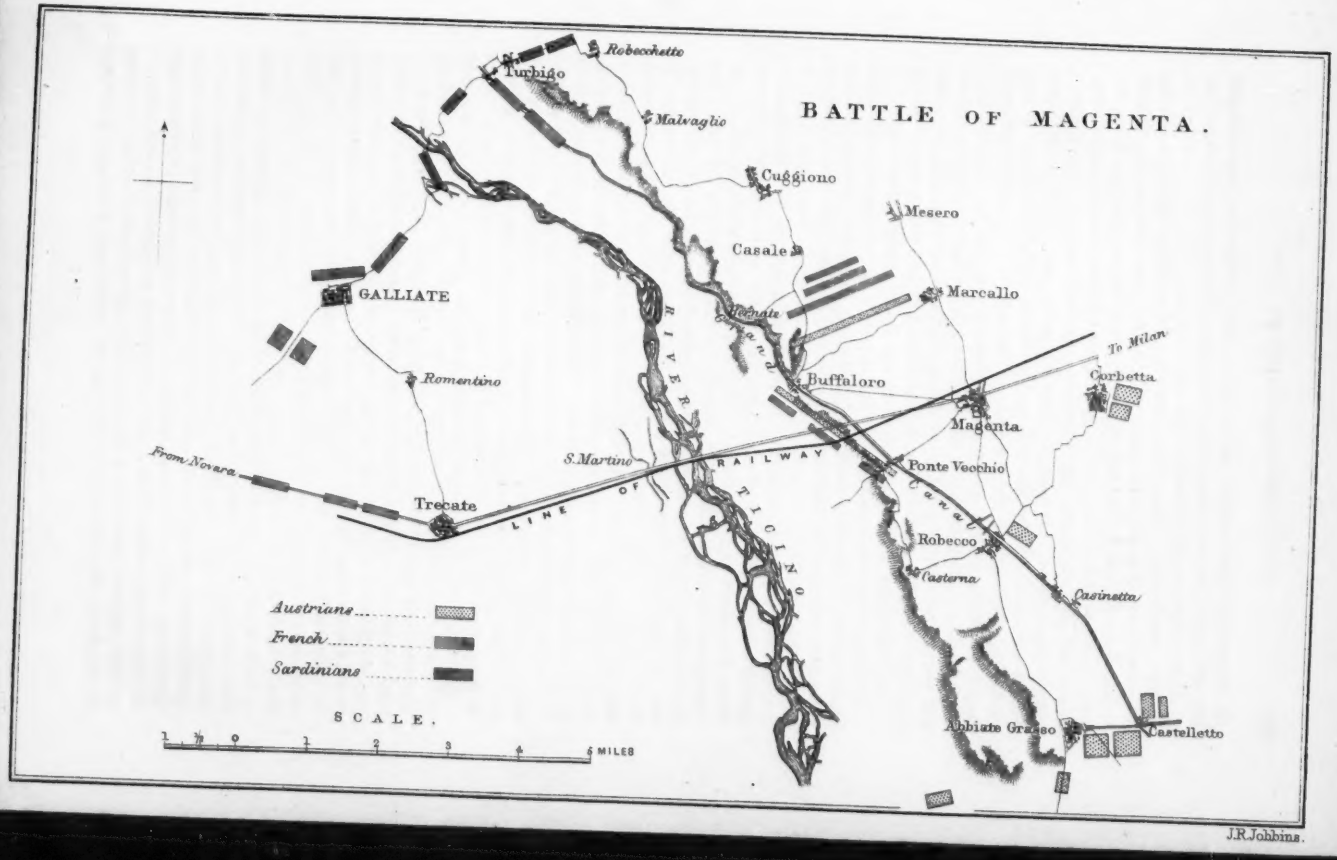
Before we enter upon the arrangements which Louis Napoleon made for the 4th June, it is desirable to understand the nature of the ground on which they were to be executed, and the features by which the details of the attack were influenced.

First there is the Ticino, with its pontoon bridges at Turbigo and its stone bridge at San Martino; the latter, though partly damaged by the mine, was passable for infantry, and could soon be made available for cavalry and artillery. After crossing this bridge there is a flat alluvial plain 1½ mile wide, and then a steep ascent of 60 feet or so up to the flat tableland on which the village of Magenta stands. A little beyond the bank is the Naviglio Grande, or great canal—deep, wide, and with a current of four miles an hour. The depth, width, and current would of themselves make it impassable; but in addition to those difficulties there are steep banks down to it closely overgrown by the robinia shrub—a sort of acacia, with hard, long, sharp thorns. This canal runs nearly parallel to the Ticino, and can only be crossed at the bridges over it, of which there are four in this neighbourhood — Boffalora, Ponte Nuovo di Magenta, the railway bridge, and Ponte Vecchio di Magenta.

M'Mahon was to move from Turbigo towards Magenta by the east side of the canal, having his own corps and the Voltigeur division of the Guard, 43 battalions in all, under his immediate command, and the whole of the Piedmontese in support; when the necessary cannonade gave notice of his beginning the battle, the Grenadier division of the Guard and Canrobert's corps, numbering 50 battalions, with Niel's corps in support, were immediately to attack the four bridges above mentioned. Baraguay d'Hilliers' corps was to remain near Novara, guarding the rear and the flank in the direction of Mortara.

Now let us see what forces the Austrians had available for defending their position. At Magenta, or close by it, were 26 battalions of the first and second corps. At Robecco, three miles off, four battalions of the second corps. At Corbetta, three and a half miles off, nine battalions of the seventh corps. These amount to 39 battalions, and would contain, by the Austrians' own estimate of their strength in this battle, 31,000 men.

Near Abbiate Grasso (six or seven miles from Ponte Nuovo, the centre of the field) there were the remainder of the seventh corps and the whole


BATTLE OF MAGENTA.
Robecchetto
Turbigo
Malvaglio
Cuggiono
Mesero
Casale
Marcallo
GALLIATE
Rosate
Romentino
RIVER TICINO
Buffaloro
To Milan
Corbetta
Magenta
From Novara
S. Martino
RAILWAY
Ponte Vecchio
Trecate
LINE OF
Canal
Robecco
Casterna
Casinetta
Austrians
French
Sardinians
SCALE.
1 ½ 0 1 2 3 4 5 MILES
Abbiate Grasso
Castelletto
J.R.Jobbins.

third corps, containing 22,000 men; these might well be brought into action about four or five hours after the order was transmitted. Further off, too far to be of much use that day, were the fifth corps at 12 miles' distance, and the eighth at 17 miles' distance, containing together between 30,000 and 40,000 men. The ninth corps was beyond Pavia 25 miles away. Lastly, there was Urban's flying division of 10,000 men at Gallerate, eight miles beyond Turbigo.

From the above detail it appears, that, if any indications of a battle were observed by the Austrians early in the morning, they might have 53,000 men in line by the middle of the day; and it also appears that the French battalions intended to attack them amounted to 93, the number of men in which, reduced in the same proportion as the Austrians (to two-thirds their normal strength), was 50,000. Moreover, these 50,000 were much scattered; 20,000 of them, being Canrobert's corps, were further off than any of the Austrian troops included in the above estimate, and 9,000 of M'Mahon's men, being one of his divisions, were three miles behind the rest. With regard to Niel's corps and the Piedmontese, the Allies could certainly expect little more assistance from them than the Austrians could from their own fifth and eighth corps, through their having to cross a river which was passable at only two places.

Generally then the Austrians had the balance of advantages on their own side; they held a position with great capabilities for defence, and were able to oppose the enemy with more than equal numbers, if their troops were only put in motion with reasonable alertness. Gyulai, in spite of being outmanœuvred, had still a good opportunity for redeeming his reputation, and for atoning by his readiness on the day of battle for the inactivity he had shown in his head-quarters.

And now we are come to the battle of Magenta—to the important events of the 4th June, 1859. Early that morning part of the Grenadier division of the Imperial Guard marched down to the bridge of San Martino, and advanced a little into the plain beyond whilst Sappers worked at the repairs which the bridge required. A skirmish began, but General d'Angely, commander of the Imperial Guard, arriving about half-past eleven, ordered the useless firing to cease, and prepared the whole division to attack as soon as M'Mahon's signal should be heard. Louis Napoleon came up about the same time.

At half-past one a distant firing announced that M'Mahon was engaged. Then the Grenadier division, debouching from the bridge, separated into three columns of nearly equal strength, to force a passage over the canal. The centre one attacked Ponte Nuovo and the railway bridge, which are only 400 yards apart; the right Ponte Vecchio; and the left Boffalora.

When Louis Napoleon had watched them dash up the heights, and throw themselves on the Austrian lines, he began to look anxiously for Canrobert's corps. It was not in sight. Time passed away, minutes appearing like hours, and still Canrobert's corps did not appear. Pressing demands for assistance were received from the front, but there was not a regiment which could be sent. The Grenadiers of the Guard seemed to be falling back, and there was no reserve to strengthen them. To add to the anxiety of the moment, the firing on M'Mahon's side ceased; and Louis Napoleon, believing that the grenadier battalions must be on the verge of annihilation, was just going to order a retreat when the long expected supports came up.

The supports had been delayed through the roads being encumbered with baggage. M'Mahon had been impeded by unexpected opposition. We must bring his movements up to this point.

He had first met the Austrians when he was two miles from Boffalora, and the encounter which was necessary to drive them back gave rise to the cannonade which Louis Napoleon had heard. Soon afterwards more formidable numbers opposed him, and though he attacked them with success, and by doing so aided the left column of the guard in getting possession of Boffalora, he was obliged to halt afterwards and reform his troops. Moreover, one of his divisions had not yet joined him, M'Mahon was therefore obliged to relinquish the offensive, the Austrians left him unassailed, and that cessation of firing ensued which caused such anxiety to the French Emperor.

Meanwhile the gallantry of the Imperial Guard had won success at al. three points of their attack. At Ponte Vecchio, indeed, it was but a barren result, for the Austrians, in retreating to the east side of the canal, blew up the bridge behind them, and the water was obstacle enough to save them from pursuit. But at Ponte Nuovo, and the railway, the bridge fell unharmed into the hands of the French; and at Boffalora the roadway, of which one arch had been blown up by the retiring Austrians, was partially re-established with a few planks. These planks, it is said, were laid on the broken piers and crossed by some of the Imperial Guard, under a heavy fire. Such a feat reflects equal credit on the readiness with which it was devised as on the gallantry with which it was executed.

It is now time to turn to the Austrian side. Clam Gallas, commander of the first corps at Magenta village, reported to Gyulai, between seven and eight in the morning, that masses of the enemy were threatening the position, and Gyulai told him "to hold the position," himself still remaining at Abbiate Grasso, five miles away, and sending, as he said, orders to all the other corps to hasten their advance. But what sort of orders these were, may be inferred from this fact, that the third corps, also at Abbiate Grasso, did not come up to Ponte Vecchio till near five in the evening—eight hours after the order is pretended to have been given!

Gyulai received a second report from Clam Gallas at noon, but did not himself reach Magenta till after the bridges over the canal were lost. Then he ordered Reischach's division to retake Ponte Nuovo and Boffalora, and rode away to Robecco, three miles from the scene of action, in order that he might show the brigades of the third corps what directions they were to take when they came up.

Reischach's division rushed impetuously against Boffalora and Ponte Nuovo, and regained some ground; but the French held to the houses near the canal so firmly, and disputed particular points so desperately, that the Austrians could not quite dislodge them. And it fared the same with other counter attacks which the brigades, coming up from Abbiate Grasso in succession, made on either side of the canal at Ponte Vecchio. Renault's division of Canrobert's corps, and Vinoy's division of Niel's corps, came to reinforce the Imperial Guard, and won back the ground which it had for a time lost. M'Mahon too had been joined by his own division, and a division of Sardinians was approaching his left rear, so he was prepared to co-operate again on the north side.

It was about half-past five when the final scene of the battle began; all

the way round, from Ponte Vecchio to Marcallo, the French began to close in upon Magenta, the Austrians slowly giving way before them. At the railway, at the houses on the outskirts of the town, and at the cemetery, the Austrians made a fresh stand. Brigades from the fifth and eighth corps tried hard to retrieve the day, but it was too late; they could not prevent the French from occupying that night the line which themselves had held in the morning.

Lilia's division of the seventh corps covered the retreat. The foremost Austrians occupied a line from Casterno to Corbetta; the first and second corps, completely disorganized, fell back to Bareggio, and the next morning retreated through Milan.

Gyulai had intended to recommence the attack on the 5th with the fresh troops at his disposal; but, on hearing that the first and second corps could not be calculated on for any fighting, he relinquished that design, and ordered a general retreat.

The Allies were not in a condition to follow up their victory, but they had so many fresh troops within reach, that a renewed attack upon them would have had little prospect of success. On the 6th June their leading divisions pushed on towards Milan, and on the 8th Louis Napoleon, accompanied by the King of Sardinia, made a triumphal entry into the town.

M'Mahon shared the congratulations and honours which were offered by the Milanese to the two monarchs, and enjoyed the reputation of having greatly aided the victory by which the city was liberated. When the ceremony was over, he put himself at the head of his corps to join in an attack on the Austrian rear-guard at Malegnano, a small town on the Lambro, ten miles below Milan. He was to act in conjunction with Baraguay d'Hilliers of the first corps, the latter undertaking to make an attack from the Milan road, whilst M'Mahon, crossing to the other side of the river, at St. Giuliano, took up a position which would cut off the Austrian retreat on Lodi.

The action began at half-past five, and lasted till nine. It was characterized by a brave defence on the Austrian part. The 1st Zouaves, which led the attack, suffered very severely, 32 officers and 580 men being killed, wounded, or missing in this regiment alone, whose strength was under 1,800 men. The result by no means compensated for such a loss of life. The Austrians perceived M'Mahon's advance in sufficient time to withdraw from the action without being intercepted by him, and the night favoured their retreat. A little victory, without any consequent advantage, was little worth; it did not increase the prestige of the Allies, nor was it wanted to raise the confidence of their army.

The Austrians continued their retreat towards the Mincio without further molestation, and gave up their fortified places near the Po, Pavia, Piacenza, and Pizzighettone. That Piacenza should be given up, surprised everybody; great care and expense had been bestowed upon its defences; it was almost a first-class fortress, and would be of great value to the Austrians if they should return victorious to the positions they were now leaving. Such a step as this showed that they had little confidence themselves in their future prospects.

In all this time I have not mentioned the name of Garibaldi; but he, with his usual energy, had been stirring up the population in North Lom-

bardy, had raised and organised volunteer corps, and had fought successfully on one occasion with the Austrian regular troops.

I omitted to follow his movements, because they were quite disconnected with those of the Allies, and a relation of them would have broken or interrupted the thread of the narrative. But, now that we are come to a period of the campaign when events of interest did not follow so closely upon one another, we have a good opportunity to study his career.

When the French divisions began to join the Sardinian army at the beginning of May, Garibaldi took the irregular corps which he commanded, about 4,000 strong, to Varese, in the Austrian territory, and there he proclaimed Victor Emmanuel king. The inhabitants rose in his favour, and he obtained numerous recruits for a fresh regiment, called "I Cacciatori delle Alpi," "The Alpine Chasseurs," a name which was frequently mentioned in the newspapers last year.

Austrian troops to the number of 3,000 men, detached principally from the garrison of Milan, attacked Garibaldi at Varese on the 26th May; but he defeated them, and pushing on the next day to Como, was received there equally well as he had been at Varese.

But a stronger force was on its way to assert the Austrian supremacy in this district. General Urban, with 10,000 men, was at Monza on the 27th May. On the 29th his leading troops defeated the Alpine Chasseurs, and Garibaldi did not venture to wait for the main body to attack. With a view to secure his retreat over the Lago Maggiore, he made an attempt on Laveno, where the Austrians had some steamers, which would have conveyed his forces to Pallanza on the opposite coast. A small garrison guarded the post, and Garibaldi failed in his object. His situation was therefore very precarious; he had no means of retreat, and could not risk a battle against an enemy so superior in every point—in numbers, in discipline, and in equipment. There was no prospect of safety except in a general separation—*sauve qui peut*. But, fortunately for him, the arrangements consequent on the allied flank march caused Urban to be recalled, and liberated Garibaldi from a very great dilemma.

It was in executing the orders for leaving the district that Urban's force happened to be at Gallarate, not far from Turbigo, on the day that the battle of Magenta was fought. Ignorance of that event, we may presume, on his own part, and neglect on Gyulai's part in not sending proper instructions to him, led to his remaining idle on that day, when his men might have been employed with advantage at Turbigo.

In the general retreat, after the 4th June, he marched towards Peschiera, and in course of the march twice came in contact with Garibaldi, once at Vaprio, and again at Rezzate. On the second occasion Urban might have obtained a signal advantage, if the fourth Piedmontese division had not been near enough to support and to save Garibaldi's irregular troops.

Garibaldi then went northerly, to the frontiers of the Tyrol, with the same division of Piedmontese close in his rear. He marched about 70 miles up the valley above the lake of Garda, and was skirmishing at the lake of Idro with outposts of the sixth Austrian corps, on the same day that the Allies fought at Solferino. On the 7th July he unsuccessfully attacked some troops in the pass called the Col di Stelvio, or Stilffer Joch, and with this affair ended his part in the campaign. The unexpected peace was

soon afterwards announced, and Garibaldi had to suspend for a time his efforts in the Italian cause.

And now we will return to the Allies.

Their advance from Magenta was conducted slowly and with caution—so slowly, compared with their advance to it, that, whereas in the seven days before the battle they marched 80 miles, in the nineteen days which followed it they marched but 90 miles; being only one-half the former rate. But, before the 4th June, they were endeavouring to throw their men along the enemy's front, and bring them unexpectedly on his flank; after it, they had to guard against the retreating enemy, who might at any time turn upon and attack them. Moreover, the enemy destroyed all the bridges after passing over them, and the Allies had four rivers to cross between Milan and the Mincio.

In the Austrian camp there had been numerous and important changes. Gyulai, to begin with, had laid down his command on the 17th. No one succeeded to exactly the same position. The command in chief was assumed by the Emperor himself, with Count Hess by his side as military adviser; and the next position in rank to the Emperor was shared by two officers, Counts Wimpffen and Schlick, who commanded the first and second armies respectively. Another *corps d'armée* had joined those recently engaged at the Ticino; the distant garrisons of Ferrara, Bologna, and Mantua had been called in; and the Austrian forces now comprised 171 battalions of infantry and 92 squadrons of cavalry.

Everything seemed to indicate that they intended to wait on the Mincio for the issue of the next battle, and to trust to the help of the Quadrilateral, as they had once before trusted to it, and not in vain, for regaining lost Lombardy. Even Cavriana did not tempt them to make a stand, though its neighbourhood had seemed a likely place for them to offer battle upon. They had had a camp of instruction there year after year, and the adjacent plain of Medole was well adapted for using the cavalry of which they were so proud. But they passed over the plain without a symptom of intending to fight, and posted themselves along the east bank of the river Mincio.

Yet, whilst the army continued to retire, a debate was started at the head-quarters as to whether an offensive movement might not be attended with success. Opinions differed strongly; but the natural desire of the youthful Emperor to break the monotony and tameness of their present strategy, threw into the scale a weight which overbalanced the counsel of the elder generals.

An attack upon the Allies in their march was therefore decided upon, and the necessary orders were issued for the troops to retread their steps.

It was calculated that they would find the French engaged in crossing the Chiese with their divisions in the worst possible order for an engagement, and that the disadvantages of such a position, in addition to the confusion consequent on a surprise, would make the defeat of the Allies certain.

The Austrian right wing was to occupy a position between Lonato and Castiglione; the left was to be almost at right angles to the other between Castiglione and the Chiese. These places being from sixteen to twenty miles distant from their actual positions, it was debated whether one day or

two should be allowed for the march, and the latter number was fixed upon. Breaking up, therefore, on the 23rd June, the position just taken up along the Mincio, the whole army marched westerly. The right wing, commanded by Count Schlick, occupied that night Pozzolengo, Madonna della Scoperta, and Solferino, in the foremost line; Cavriana, and the neighbourhood of Foresto, in rear. The left wing, under Count Wimpffen, bivouacked at Guidizzolo, Ceresole, and Medole, with one corps in reserve at Castel Grimaldo. The Emperor and the head-quarter staff slept at Valeggio.

Part of the reserve cavalry belonging to this wing, rather less than one-half of it, was detached to Gazzoldo in order to join on the following day a division of the second corps, which was sent round by Marcaria with a view to its coming upon the Allies' extreme right when battle was offered. I may, however, mention at once that this division was not engaged, for Prince Liechtenstein, becoming aware that a considerable number of French were at Piadena, failed to carry out the design, and had no share whatever in the battle of Solferino.

The general march of the Austrians was to be resumed on the morning of the 24th; they might, it was supposed, meet the enemy in the afternoon; but that the enemy should come upon them before they began to move was not for a moment expected.

To explain how the collision was brought about, we must turn to the side of the Allies. They, on the night of the 23rd June, bivouacked in a line from Desenzano on the lake of Garda to Mezzano on the Oglio. The appointed routes for the various corps on the 24th were as follows:—

Four Piedmontese divisions, from Desenzano and Lonato to Pozzolengo by Rivoltella and Madonna della Scoperta.

First corps (Baraguay d'Hilliers) from Esenta to Solferino; one division by the direct mountain road through Astore, the other two by Castiglione.

Second corps (M'Mahon) from Castiglione to Cavriana, by the Guidizzolo road for the first four miles.

Fourth corps (Niel) from Carpenedolo to Guidizzolo by Medole. The cavalry regiments attached to the different corps were formed into two divisions under Generals Partouneaux and Des Vaux, and accompanied this corps.

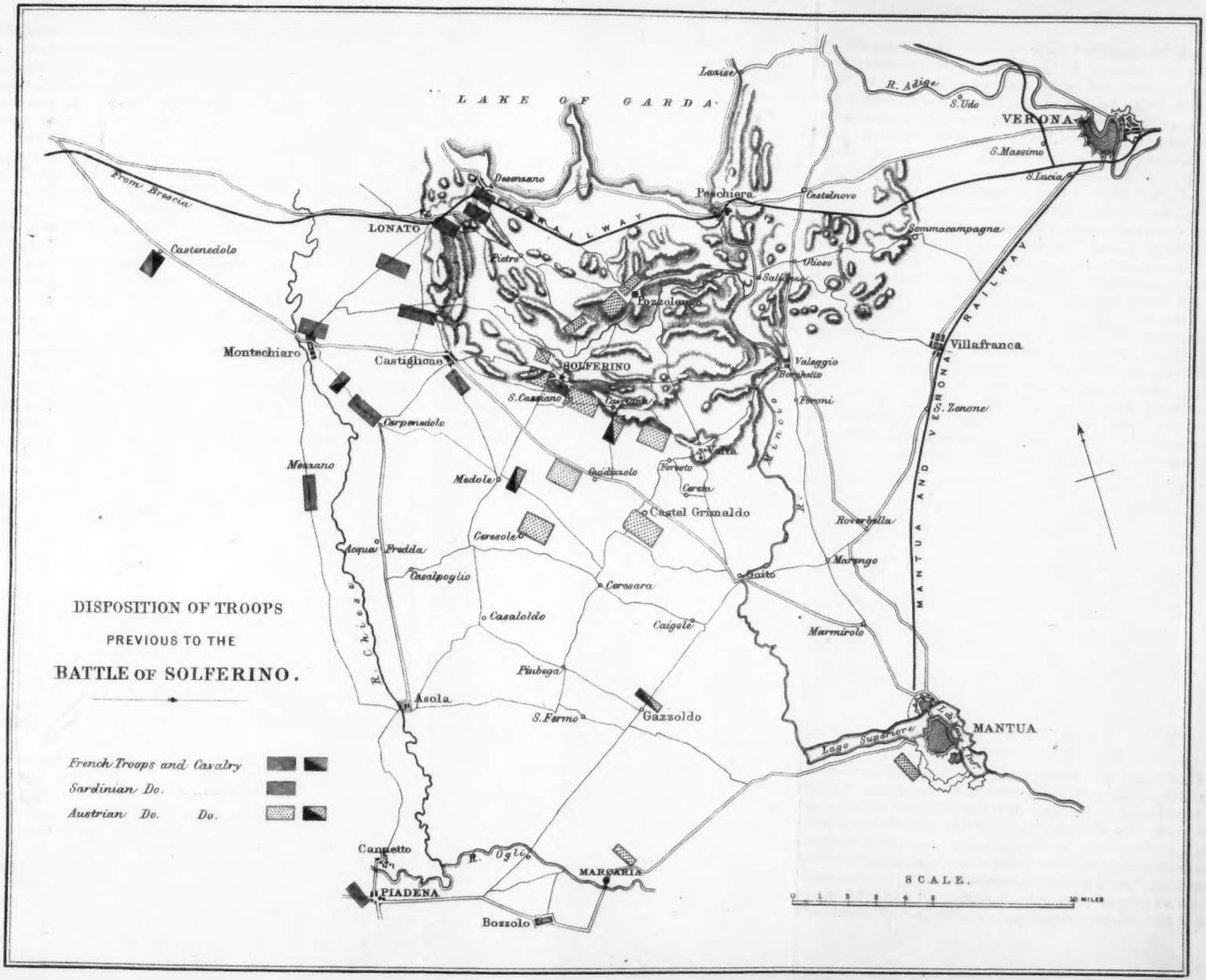
Third corps (Canrobert) from Mezzano on the left bank, to cross the Chiese by a pontoon bridge near Visano, and proceed to Medole by Castel Goffredo.

Imperial Guard (D'Angely) was in rear of the rest at Montechiaro, and to march to Castiglione.

The cavalry of the Guard and artillery, 36 squadrons and 8 batteries, were still further back at Castenedolo, 14 miles from the plain of Medole.

At Piadena on the Oglio, 15 miles south of the battle-field, was Autemarre's division of Prince Napoleon's corps, intended to join the rest of the army at the Mincio. Its presence there, unexpected by the Austrians, embarrassed Liechtenstein at Marcaria, and had thus some effect on the battle.

You see, therefore, that the appointed lines of march for the two armies on the 24th actually crossed one another, so that a collision was inevitable; and, with the hostile outposts already so close, it must necessarily begin at


LAKE OF GARDA
Lazise
R. Adige
S. Udo
VERONA
S. Massimo
S. Lucia
From Brescia
Desenzano
Peschiera
Castelnovo
LONATO
RAILWAY
Sommacampagna
Castenedolo
Pietro
Ulioso
Salionze
Pozzolengo
Villafranca
Montechiaro
Castiglione
SOLFERINO
Valeggio
Borghetto
S. Cassiano
Cavriana
Pozzuni
S. Zenone
MANTUA AND VERONA RAILWAY
Carpenedolo
Volta
Mezzano
Medole
Guidizzolo
Foresto
Cereta
Castel Grimaldo
R. Mincio
Roverbella
Acqua Fredda
Ceresole
Marengo
Casalpoglio
Goito
Ceresara
Casaloldo
Caigole
Marmirolo
R. Chiese
Piubega
Asola
S. Fermo
Gazzoldo
MANTUA
Lago Superiore
Lago Inferiore
Canneto
R. Oglio
MARCARIA
PIADENA
Bozzolo
DISPOSITION OF TROOPS
PREVIOUS TO THE
BATTLE OF SOLFERINO.
French Troops and Cavalry
Sardinian Do.
Austrian Do. Do.
SCALE.
0 1 2 3 4 5 10 MILES

an early hour. Let us, in anticipation of it, take a glance at the scene of action. It presents two distinct features: its northern part is very hilly, the southern is very flat. In general respects it combines to a wonderful degree the peculiarities best suited for infantry, cavalry, and artillery. For the artillery there are excellent positions on the spurs and ridges of the hills, with, generally, an ample range for their fire. For the cavalry there is the wide plain of Medole, immediately under the hills (and this was the first time in the campaign that cavalry and artillery had met such advantages). For infantry there is both broken ground and level ground; open spaces for battalions to deploy, and bits of cover for skirmishers to display their skill. Houses and villages, walls and enclosures, offer numberless positions of importance to call for gallant attacks, and to give occasion for gallant defence. Principal among these positions are the cemetery and convent, or *palazzo communale*, of Solferino, occupying, with their thick walls and lofty towers, the whole width of a high ridge. Higher still is the venerable ruin called the Spia d'Italia, from which the whole field of battle, and many a league beyond it, may be plainly seen. What more fitting field could be chosen for a great battle? And what battle could be greater than one in which 300,000 men, headed by two emperors and a king, contended for the victory?

The close equality of the two armies in point of numbers, and in most other respects, adds to the interest of the battle. Neither army contained much more or less than 150,000 men, and neither commander had selected his ground, or prepared for the combined employment of the individual corps. The Allies were moving along seven different roads, the furthest about twelve miles apart. The Austrians had a front of only ten miles; they had, or ought to have had, a superiority in number of guns; and had, certainly, the best positions for artillery. So far the advantage seemed to lie on their side; but the Allies were all on foot, and ready to carry out any change in the orders for the day, whilst the Austrians were still stretched round their bivouac fires, or beginning to prepare their morning meal.

We saw how impossible it was that the Allies should march far on the 24th June without coming in contact with the Austrians. Now the former started at two o'clock in the morning to avoid the great heat of the day; and so it happened that daylight was only beginning to break through a thick mist when the first shots of an outpost, a mile and a-half from Castiglione, opened the battle. Other shots were soon heard, extending to the right and left; cannon began to join in the affair; and a line of fire from San Martino to Castel Goffredo, eleven miles in length, indicated the magnitude of the contest which had begun.

At the first sound of a cannonade, Louis Napoleon hastened from Montechiaro towards Castiglione. At first, he supposed that his troops had met some reconnoitring columns. He received on the way reports which convinced him that no reconnaissance, but a great battle, had to be dealt with; and he considered what measures it would be necessary to take.

He knew that his front of twelve miles was too long for the number of his troops. His first step was therefore to send orders for the right and left wings to close as much as they could to the centre, and for the guard in rear to hasten up and form a reserve. His next step was to study the enemy's line of battle, that he might discover what weak points it presented, and direct his own forces upon them. The heights of Solferino appeared the

most vital point of the enemy's line, and he determined to make their capture his principal object.

He came to this resolution early in the day and communicated it at once to the corps commanders. It was moreover in accordance with the orders he had already given; yet some time necessarily elapsed before the generals could do much to further it.

The first corps was already marching direct upon Solferino, and formed the centre towards which the others were to converge; but it was necessary that all the corps should alter their direction simultaneously, or else a dangerous interval would be left between them. M'Mahon, therefore, who was on the right of the first corps, was dependent upon Niel; Niel was dependent upon Canrobert; and Canrobert was instructed to guard against a flank attack from that part of the second Austrian corps, of whose movement towards Marcaria information had been brought. None, therefore, of the French corps on the right wing were able to alter their position on receipt of the orders; and on the left wing the Piedmontese were decidedly overmatched, and still less able to strengthen the centre.

Canrobert did not satisfy himself till three o'clock in the afternoon that no attack was to be apprehended from the direction of Marcaria. But the cavalry, which had come up a few hours after the battle began, had strengthened the line sufficiently for M'Mahon to move to his left, and the Imperial Guard had joined the first corps in the middle of the day. By its aid the village and heights of Solferino, once assaulted in vain, were again assaulted and gloriously won, and the three corps, advancing in unison, slowly pressed back the Austrians towards Cavriana.

By the time they were prepared to attack that village the Austrians had begun to withdraw their men. To the French attacks, well conceived, well combined, and bravely executed, the Austrians had opposed, throughout the day, a merely defensive resistance. One by one the reserve brigades drifted into the battle, and not till Solferino was lost did the generals attempt to use their forces with any object beyond holding the ground on which they stood. Then they proposed to make an attack with their left wing, and hoped to gain on the low ground some advantage which would compensate for what they had lost on the hills. But it was too late. Niel's energetic efforts had already brought the reserves into requisition, and of the troops which the Austrian staff calculated on employing only one fresh brigade remained. They tried, however, to retake Casa Nova and Robecco. The failure of the attempt settled the fate of the battle. Benedek, indeed, had held his ground at San Martino, but his isolated success was not sufficient to retrieve the general disaster, nor to alter the decision for a retreat of the whole army.

From daylight till evening, on a long summer's day, lasted this great battle. Hardly was it over then. On the left the Sardinians, hitherto unsuccessful, but still undismayed, were preparing one more effort to win the heights of San Martino. In the centre the victorious French were pressing on to harass the retreat, and on the right Niel was counting on the capture of Guidizzolo, as a glorious termination to his gallant achievements, when a violent storm intervened. Violent with wind, darkening the sky with heavy rain, bewildering the senses with the glare of its lightning and the crash of its thunder, it swept like a hurricane over the field. Yielding to the power of the elements, both parties laid aside their arms. It seemed as if nature herself had interposed to stop their weary strife.

I have given this short outline of the battle in the hope of conveying a clear idea of its general features.

With regard to its details, you will see that it very much resembled three simultaneous and concerted actions, because the troops of the allied army were acting almost in three distinct masses, and each mass had a particular object in view, with due regard to the general plan of supporting the centre. The left wing (Sardinian army) tried to gain possession of the heights of San Martino, and the position of Madonna della Scoperta. The centre, in which we may include the first and second corps and Imperial Guard, united in gaining the hills from Solferino to Cavriana. In the right wing, Niel, scantily assisted by Canrobert, aimed at the capture of Guidizzolo. To examine, therefore, the details, we had better take each division separately, and will begin with the centre one as the most important.

The first corps had orders to march from Esenta to Solferino; but, as there was no good road direct from one to the other, only L'Admirault's division went the nearest way by Astore; Forey's and Bazaine's, with the artillery, marched through Castiglione. This obliged the second corps, M'Mahon's, which was going from Castiglione to Cavriana, to follow the Mantua road for some distance, in order to leave the other unimpeded.

Both met the enemy about five o'clock; but, whilst L'Admirault's and Forey's divisions of the first corps advanced steadily towards Solferino, driving back the enemy before them, M'Mahon was obliged to act more on the defensive. He took, after some fighting, the farmhouse called Casa Marina, because the possession of it seemed important; and then, deploying across the road, he received an attack from Clam Gallas' corps.

This attack he would hardly have sustained if the cavalry of the line had not come up to strengthen the interval between him and Niel, or if the French rifled guns had not shown the deadly power of their fire. But with their aid he was able to hold his ground; and, moving troops gradually from the right to the left of his line, in order to draw closer to the centre, he prepared to take the offensive as soon as circumstances would permit. The centre corps, the first, was taking a more prominent part; it had indeed fought all the way from Le Fontane to Solferino; once or twice its divisions were repulsed; at other times they had to guard against manœuvres threatened by the enemy; but soon after ten o'clock they were under the village of Solferino itself.

L'Admirault's division threatened the hamlet of San Martino on the north side of the ridge; Forey's prepared to attack the cemetery and Cypress hill from the west and south. A heavy cannonade thundered along the whole line.

About eleven o'clock the Imperial Guard had formed up in rear of the first corps, and Louis Napoleon, having now a reserve to fall back upon, ordered the attack. It was well that he *did* wait for this reserve. The assaulting divisions were not equal to such difficulties as had to be overcome. L'Admirault, indeed, penetrated into San Martino, but both Forey's two brigades were driven back with heavy loss. A terrible cross-fire from the cemetery and Cypress hill swept through their ranks, and the cemetery in particular seemed to defy their efforts. A heavy artillery fire

was therefore opened against the whole position, and guns were sent up to within 300 yards of the cemetery.

To this fire its walls began to yield; then Bazaine's division made a fresh assault, and then a brigade of the Imperial Guard assisted in a fresh attempt upon the Cypress hill and the old tower. To this combined attack the defenders offered a stubborn but ineffectual resistance. Their case was hopeless. They had been terribly weakened by the first general attack; they were reduced by losses and by disorganisation almost to one brigade; and their reserves were scanty and badly brought up; whilst Louis Napoleon had still three brigades of the Imperial Guard with ranks unthinned and eager for attack. At half-past two the Austrians were in full retreat from this point, leaving four guns and two standards in the hands of the French.

The taking of Solferino was THE event of the day. This success alone, if not counteracted in another part of the field, would have settled any dispute as to the side with which victory lay. The choice of Solferino for the name by which the battle should be known has been unfavourably criticised, and Cavriana has been suggested as more appropriate. But I think that Solferino, as being the most central point of the line of fighting, as being the most marked by natural and artificial features, and particularly as being the point on which Louis Napoleon's arrangements hinged, presents the greatest claims for the historical honours of the day.

About the time that the French gained a footing in Solferino, M'Mahon, having been further strengthened by the cavalry of the Guard, obtained possession of San Cassiano. After that there was a pause in the centre, until the first corps, the Guard, and the second corps were able to make a joint advance towards Cavriana. Parts of various Austrian corps presented themselves to check the movement; and the Prince of Hesse, in particular, took a gallant and leading part in opposing their progress. To do more than impede it was impossible, but the French were restricted to slow and cautious movements, and by the time they were ready for a serious assault upon Cavriana the Austrian divisions had evacuated it of their own accord. It was no longer a question of saving the day, but of conducting an orderly retreat.

Thus we conclude the operations in the centre; we will next examine the incidents in the plain, where Niel was endeavouring to get possession of Guidizzolo, and thus to command one of the roads by which the Austrians would retire from the centre.

It was with the intention of halting at that very village that Niel's corps left its previous bivouac at Carpenedolo. On coming to Medole, between six and seven o'clock, Niel found it occupied by the enemy. Here the fighting began, but the few infantry and cavalry who held the village soon retired from it, and Niel followed them half-way to Guidizzolo, as far as the farm called Casa Nova.

Here he formed his line: the right pointed towards Ceresole; the left was thrown back towards M'Mahon's corps, which was a mile and a half to his rear. As that corps advanced towards San Cassiano, Niel's left moved up likewise; but for six hours, from nine in the morning till three in the afternoon, the contest was restricted to nearly the same ground. And it is saying a good deal for Niel and the fourth corps, to say that it was on the same ground, for the enemy's superiority in numbers was very great. The

third corps, the ninth, and four out of the five brigades composing the eleventh, were all in Niel's immediate front, and all were employed sooner or later principally against him. Their infantry must have been at least half as strong again as his own. To counterbalance these odds, he had two advantages over them: advantage in the number of cavalry, and in the range and accuracy of artillery; 42 guns in line on his left flank covered the interval between the fourth and second corps, and kept up a continued fire which the enemy might well hold in respect. The cavalry were in rear of the guns.

For his advantage in cavalry, Niel was indebted to an extraordinary incident—an incident so strange that it seemed at first hardly credible, but it proved an incontestable fact. Sixteen squadrons of Austrian cavalry, with the accompanying horse artillery, were taken off the field by their immediate commander without orders. Count Zedwitz, who commanded the reserve, had been at Medole with six squadrons in the morning, and when he came to the plain expected to find there Lauingen the next in command. Lauingen was not to be seen. Zedwitz himself went in search of him. So, between the two, the Austrian left wing lost its main strength of cavalry, and the small part which remained was without its proper chief. Craving hunger, absolute want of food, is the cause assigned for this extraordinary defection,—it is stated that neither men nor horses had received rations during the previous thirty-six hours.

Sometimes having to give way to superior numbers, sometimes recovering his ground by a judicious employment of his reserves, Niel held out until, in compliance with his repeated and pressing demands, Canrobert began to furnish assistance. The latter had been watching until now against an attack from some Austrians who were supposed to be near Acqua Negra. In compliance with the first demands for co-operation (between nine and ten), he sent six battalions and two guns, which *did* strengthen a little Niel's right. All further demands (and they were both many in number and urgent in tone) failed to shake his resolute inactivity until after two o'clock, when he began to think no very serious attack from Acqua Negra need be apprehended. One by one he allowed his divisions or brigades to join the fourth corps. With the arrival of the first instalment, at three o'clock, Niel attacked Guidizzolo; but meeting there the Austrians formed for the counter attack, as already described, the attempt failed. With another reinforcement from the third corps, Niel, still intent on the possession of the village, organised a second attack. But in the moment of executing it, just as the troops had gained some advantage, and were pushing on in the flush of success, that violent storm already mentioned burst over the plain and put a final stop to Niel's gallant exertions.

It still remains for us to study the conflicts waged by the Sardinians, on the left wing of the Allies, in that hilly tract of country which lies between Solferino and the lake of Garda. Their destination being Pozzolengo, which is within four miles of Peschiera, their divisions were preceded by reconnoitring columns along the roads from Lonato and Desenzano. By the former they met the Austrians at Madonna della Scoperto, and by the latter at San Martino. Their efforts were simply directed to dislodging the enemy from these points, and

they did not obtain sufficient success to co-operate in Louis Napoleon's designs. So far indeed from drawing in to strengthen the centre at Solferino, one of their brigades had to strengthen the extreme left at San Martino, where their danger was serious. Indeed, the whole of the operations on this side were so independent of the rest, and so far removed by distance from them, that they formed almost a separate battle, and the Sardinians usually call their share in the contest the battle of San Martino.

It was at a small plateau on which a little church dedicated to St. Martin stands that the severity of the engagement was greatest. The Austrians, driving back one of the reconnoitring columns which came upon them in the vicinity, took up a position on the heights; and the Sardinians, bringing up one brigade after another, made a fresh assault with each as it arrived. Their attacks were impetuous, the men fought gallantly, but they were each time received by a superior force and repulsed with a sensible loss. Once they forced back the Austrians to the highest points of the position—if they could only have prolonged their efforts but a little while their success would have been achieved. But they were exerting their whole strength; and Benedek, who commanded the Austrians here, was not quite at his last resource. As the Piedmontese slowly crowned the heights, thirty pieces of artillery suddenly opened a fire upon them at 250 yards' distance. The effect of such a discharge may be imgined. The Sardinian battalions were shaken, they recoiled before such a volley of grape, they staggered under such a storm of iron hail. They began to yield the ground they had won; they had no reserve so placed that they could rally behind it; they were pressed closer and closer by the Austrians, and soon their retreat became a flight. Two of the brigades did not halt to reform their scattered battalions until they were two miles from the battle-field.

One fresh brigade had just reached the scene of action in time to witness this repulse. It now took up a defensive position along the railway, in conjunction with one of the brigades already engaged—partly to keep the communications open with all points in the rear, partly to be ready for another attack when further reinforcements should arrive. Benedek left this arrangement undisturbed; he could not pursue the advantage he had won on account of the unsatisfactory reports he received from the other Austrian corps on his left.

Thus, for three hours, there was a lull in the battle of San Martino. It was four o'clock, when a brigade from the second Sardinian division came up; the troops were then disposed for another attack of the heights. The two brigades which had not yet been under fire were placed in front; the two which had left the field were recalled, and ordered to extend the attack on the left; and the remaining brigades formed a support. The thunderstorm which raged soon after the attack was begun interrupted it for a time, but only for a time; it began again when the violence of the rain ceased, and this time the Sardinians had the gratification of seeing the Austrians retire from the disputed ground. Naturally enough, they attributed the abandonment of the position to the force of their own arms; naturally enough, they are unwilling to adopt any other view less flattering to their honour; and to this day they describe the battle of San Martino as a splendid success. But the Austrians deny that they retired for any other reason than the receipt of superior orders, which

were issued when the retreat of the whole army was decided upon. Benedek is said to have complied with these orders only from positive necessity to obey them, and to have expressed himself bitterly on being thus obliged to surrender the position he had so well defended.

The view taken by the Piedmontese is not supported, so far as I know, by any other writers. Of two, apparently impartial authors, one says that the claims to the victory are equal on both sides; the other awards it to the Austrians. A very recent critical account by a French author gives it positively to the Austrians. "Benedek," the writer says, "quitta malgré ses dents le champ de bataille où il avait vaincu." Perhaps in this instance we should make some little allowance for national jealousy, and bear in mind that the French glory is brought into stronger relief by the Sardinian reverse. But I see no reason to suppose that this last attack of the Sardinians would have had any better success than the others; it was conducted on the same plan as they had been; and the effect of the previous encounters on the *morale* of the soldiers must have been all in the Austrians' favour. That Benedek was ordered to retire there is no doubt. I think that his retreat was caused by those orders, and not by the hostile force, and therefore I think him entitled to the honours of the day. Nevertheless, let the Sardinian soldiers have due praise for the gallant way in which they fought; they yielded to better generalship rather than to better men; and the heavy loss they suffered, a loss greater than any French corps, proves that they did not yield too soon.

San Martino was not however the only place at which the Sardinians fought. At Madonna della Scoperta—the church of Our Lady on the "Wold"—they had another conflict with parts of the eighth and fifth corps. Here, also, they fought in the same manner, and with the same result, that is to say, the reconnoitring column along that road opened the engagement, and was repulsed; reinforcements coming up, one by one attacked in their turns, and were also repulsed; and, finally, they got possession of the place, by the defenders being withdrawn, in consequence of the loss of Solferino. There were only two-thirds of the number of Sardinians engaged here that there were at San Martino; and the losses were not half so severe in proportion to their number.

Benedek's share in the battle of Solferino is the only one taken by the Austrian corps' commanders which we can study with interest—almost the only feature of the Austrian operations on which we can dwell with satisfaction. It is not that the Austrian defeat was overwhelming, or their confusion extreme—far from it; their retreat was unmolested, and their rear-guard occupied such places as might be useful for covering it, so long as the occupation was desirable. But it is disappointing for the military observer, and sad for any one who sympathizes with their cause, to see how want of generalship, and want of unity of purpose, prevented the development of their real strength, and entailed the overthrow of their magnificent army.

After the battle of Solferino, there is little to add to the narrative of the campaign. The Austrians took shelter beyond the Mincio, the passage of which by the French they did not oppose. The Allies prepared to besiege Peschiera with part of their forces, whilst they covered Verona and Mantua with the remainder. But already Louis Napoleon had been

reported to be desirous of peace, and on the 2nd of July an opportunity occurred for opening negociations.

The Austrian Prince Windischgratz had fallen at Solferino, and his family was anxious to learn particulars of his fate. Lieut. Field-Marshal Urban, commandant of Verona, came to Louis Napoleon's head-quarters to make inquiries on the subject; and after his visit frequent messengers passed to and fro. On the 8th July it was arranged that arms should be laid aside for six weeks; but before the six weeks were over a formal peace put an end to the war.

Let me, before concluding, sum up in a few words its principal events, which will then be more firmly impressed upon your memory.

The Austrians invaded the Sardinian territory with a force far larger than that which the unassisted Sardinians could oppose to them. Neglecting the opportunity which their superiority offered, the Austrians only made a few demonstrations, and then took up a position behind the Sesia and the Po, leaving the French and Sardinians to unite their forces at Alessandria.

To ascertain the strength of those forces, and the intended movements of the Allies, Gyulai sent towards Voghera, on the 20th of May, a strong column, which was encountered and defeated at Montebello. And, as the aspect of affairs was much changed by the end of May, we may consider that this action completed the first phase of the campaign.

The second begins when the Allies, ready for active operations, threw all their troops in a most rapid and unexpected manner from Voghera to Novara, drove back the Austrian outposts at Palestro, and occupied two undisputed points for crossing the river Ticino before Gyulai would be convinced that they had changed their original position. Pushing on from Novara towards Milan, they found the enemy posted along the Naviglio Grande. Before they could advance further they had to fight the battle of Magenta. They won all Lombardy by that single blow, and the Austrians withdrew to defend the frontier of Venetia.

Suddenly, however, the Austrians retraced their steps in the hope of crushing the allied army at the Chiese. So far from succeeding in their design, they were taken unawares at Solferino themselves. Unprepared for such a contingency, and unequal to the crisis, they were again defeated, and again retired to the shelter of the Quadrilateral.

Not yet, however, driven out of Italy, nor broken in spirit, officers and men hoped for another occasion to try their strength,—another opportunity to retrieve their losses. What the issue of another action would have been, no one can say. The other battles had not been easily won, and the Austrians are celebrated for the manner in which they endure defeat without yielding to despair. But superior considerations ruled that no further opportunity should be given them; and closed, to their mortification, the Italian Campaign of 1859.

Friday, April 26th, 1861.

Lieut.-General W. F. KNOLLYS, Vice-President of the Council of Education, in the Chair.

THE ITALIAN CAMPAIGN OF 1859.

By Major MILLER, R.A., *V.C.*, Topographical Staff.

PART II. GENERAL REVIEW.

O! for one hour of Wallace wight,
Or well-skilled Bruce, to rule the fight!
Another sight had seen that morn,
From Fate's dark book a leaf been torn!—MARMION.

IN the lecture which I had the honour to deliver here a fortnight ago, we traced the course of the principal events in the Italian Campaign, and I will briefly recapitulate them to-day before proceeding to the review which I propose for this afternoon's subject.

When hostilities began, the Austrians had the start of their opponents, by being able to cross the Sardinian frontier on 29th April with 150,000 men, when the Sardinians had only half that number to oppose their invasion. They let this opportunity slip away without taking advantage of it, and permitted the Allies, unopposed, to assemble their forces around Alessandria.

Then the Allies took the offensive; outwitted the Austrians by a rapid march from Voghera to Novara; encountered and defeated them at Magenta; and won Lombardy from them by that single battle. Following them afterwards, with the expectation of fighting again on the banks of the Mincio, under the guns of Peschiera and Mantua, the Allies unexpectedly found the Austrian army in its full strength at Solferino. Joining battle along a front of ten miles, the Allies fought the greatest action that has taken place since the wars of the French Empire, and forced the Austrians to retire a second time behind the Venetian frontier. Peace intervened before any other encounter took place between them.

So the campaign, which began with equal prospects of success on either side, and which appeared likely to last through the summer without decisive result, ended in ten weeks. The Allies were triumphant; the Austrians, beaten in two general actions and three smaller encounters, had scarcely gained one advantage to set off against the uninterrupted success of their adversaries.

Now why should this have been? Why should one of these, apparently so equal, armies have failed entirely to justify the opinions formed about its prospects? I propose that we should consider that question this afternoon, and determine, if we can, by analysing the circumstances, how far the failure may be attributed to the neglect of acknowledged rules, or the faulty manner in which military principles were applied.

If the inquiry were to decide what position this campaign is entitled to

hold in all military history, and to determine the rank in which the principal commanders should be placed among generals of all ages, I should be obliged to review not only what was done, but what might have been done; to point out the omissions which where made as well as the faults which were committed; but time fails me for such an inquiry, and I must restrict myself to the simple question—What caused the Austrian defeat?

First, in order of precedence, has to be examined the strategy displayed by both parties; using that term to express their general plan of operations, and the principal movements by which they carried it out.

Well, in strategy, I think neither side gained much advantage over the other. If the Austrian proceedings were not bold, neither were they injudicious; if the French plan, in which the flank march forms the principal feature, was daring, it was likewise hazardous, and its success was due rather to the skilfulness of its execution, and the extraordinary blindness of the enemy, than to any originality in its conception.

Every one was surprised, and every reader still wonders, that the Austrians threw away the advantage of numbers which the absence of the French gave them at the outset of the war. Sooner or later, no doubt, they must have been reduced to act on the defensive. They might have delayed that period by hindering the French divisions which landed at Genoa from marching uninterruptedly up to Alessandria, or, in anticipation of the French arrival, they might have made a dash at Turin, lying defenceless under their grasp, and so they would open the campaign with the prestige of holding the enemy's capital. If, however, they chose, as they did choose, to take up a defensive position at once, that choice had no share in their subsequent mishaps.

The position which Gyulai had selected was very strong, for his whole front was covered by a river of great width and depth (and no operation is more difficult than to cross such a river in front of a watchful enemy). His left flank was protected by the fortifications of Piacenza, a very important fortress. His right flank was not so strong, but had also a river to cover it. Moreover the strong part of his line was opposite the place where the Allies would assemble their troops, and it was not to be expected that thousands upon thousands of men could be moved forty or fifty miles, and thrown across the Sesia river, without Gyulai perceiving the design in time to frustrate its success.

Nevertheless the thing which seemed so improbable was really done. Its success is due partly to the care with which the intention was concealed, partly to the rapidity with which the various corps were conveyed to Novara, but, in a great measure, to Gyulai's obstinate conviction that the appearance of allied troops on his own side of the Sesia was only a feint to deceive him. Whilst he was strengthening his troops in the centre, the "Times" correspondent with the Austrian army was expressing a conviction that the real danger lay on the north-west, and the Allies were on the point of verifying that opinion.

Yet, late as it was before Gyulai would make any alteration in the disposition of his troops, he had still time enough to protect the capital of Lombardy, and to join battle along the Ticino and the Naviglio Grande, at Magenta, in a position of equal strength to any which the river Sesia afforded.

That the Austrians should retreat towards the Quadrilateral, after their defeat at Magenta, was natural enough, and perhaps they were wise to retire under the shelter of their fortresses, behind the rapid Mincio, without disputing the passage of the less important rivers which lie to the west of it. The very disorganized state of the first and second *corps d' armée* after the battle of Magenta is said to have prevented any position being taken up in the south of Lombardy, near Pavia or Piacenza, which would have threatened the Allies' flank.

At the Quadrilateral the Austrians could best reorganise their army and incorporate with it the reinforcements which had arrived, and the distant garrisons which had been called in. As to the advisability of leaving the Mincio line, after once occupying it, and retiring towards the Chiese as they did, opinions differ. The general design seems to me good, but its success depended on a great nicety in the details of its execution, and very much on those peculiar points in which the Austrians do not excel.

It wanted, for instance, very accurate information of the allied movements, considerable rapidity of marching, foresight to provide against meeting the enemy sooner than expected, and a commander skilful enough to remedy those shortcomings which must be experienced in a greater or less degree.

In every one of these points the Austrians failed. They got no intelligence of the allied movements on the 23rd of June. They could not march rapidly, because the baggage trains which followed them to the Mincio still encumbered the roads, and they made no provision for any unexpected emergency: consequently their design proved abortive.

Still I think that the *outline* of their plan was good; that if the details had been better treated it might have had a different result; and I am sure that if it had proved successful it would have been highly praised as a specimen of consummate military skill. In thus attempting the issue of a battle, they risked but little; if they lost, they had the Quadrilateral close to them, under the guns of which they could again reform their divisions. The fact of the Mincio being in their rear was no objection to an engagement near Solferino; for they fought so far from the river, and had so many bridges across it, that their retreat would be easy enough so far as that was concerned.

On the other hand, the Allies were now expecting reinforcements, and it was desirable to attack before such reinforcements arrived; there was also a good chance of the Allies advancing carelessly, when they found that the Austrians showed no sign of opposing their progress. And chiefly it is to be remembered, that, if the Austrians won a decisive victory at this period, all Lombardy might be recovered, for the Allies had no position to fall back upon, no fortresses nearer than Alessandria and Casale to help them. But, if the Allies were allowed to establish themselves as a besieging army, they would be able to prepare against such a contingency; and a victory over them then would not bring with it any such decisive result. Therefore, although I think the movement towards the Chiese was one in which the Austrian slowness would tend to their disadvantage, I consider they did well in adopting it. Their defeat was due, not to the inherent faults of the design, but to the errors which they made in its execution.

With all their shortcomings, the Austrian arrangements previous to the battle of Solferino promised more success than those which preceded any other of the battles; their divisions were well placed; the several *corps d'armée* could give one another mutual assistance, and their commanders had a definite object in view. But this is encroaching on another part of the subject.

We have now considered the *strategy* as well as time will permit; we will therefore proceed to the *tactics* employed on both sides; using this term "tactics" to express the dispositions which were made with a view to any particular operation or battle.

First of the battles in order of time comes that of Montebello. Here 18,000 Austrians were sent twelve or fifteen miles away from their main body to induce the Allies to display their force.

Three brigades crossing the Po at Vaccarizza were to join a column under General Urban coming from Stradella, then the whole were to advance under the command of Count Stadion and threaten Voghera in such a manner that the Allies would place their troops in position to defend the town. Stadion was to calculate their number and then return.

Now in such a country as the Lombardo-Venetian plain, where all the fields are planted with fruit-trees, where vines grow between the trees, and the whole country resembles one vast orchard, it is impossible to see clearly a body of men at even a moderate distance off. Therefore, to form an estimate of the Allies' strength, Stadion must needs bring his small detached force so near to the main body that an action would be inevitable if *they* chose to begin one.

If the Allies saw an advantage of numbers on their own side it was only to be expected that they would do so. If the general in command of their advanced troops were impetuous and daring, he might possibly scorn to wait for an advantage in numbers and commence hostilities at once, certain of sufficient support coming up sooner or later. In either case danger to the Austrians must ensue. And so 18,000 men were depatched by Gyulai to count the enemy's troops at the imminent risk of their own annihilation. Allow me a slight digression to illustrate the theory of a reconnaissance.

When in 1854 the English forces occupied Balaklava, the Russians could send a column far enough into the open valley to cause our regiments to form under arms, whilst observers on the high points of ground estimated our available forces. And there was every facility for doing this without the column approaching so close as to give us the choice of a battle. But at Montebello it was different. If you would judge for yourselves of the impediments there, you have only to go to the top of the Green Park and imagine you have to reconnoitre the troops in the Wellington Barracks. You will see that the trees and the shrubs between you and the Birdcage Walk entirely shut out the parade ground, so that you must go close up before you can distinguish the figures upon it. And it was the same thing at Montebello.

Taking this view of Stadion's mission, that he must either put his head into the lion's jaws or return without executing his orders, I think we need not say worse of his generalship than that there is nothing to praise in it. He did not employ his reserves well, and perhaps he should have avoided all fighting if possible; but that his line should be an extended one was neces-

sary, in order that the Allies might extend and display theirs. Some excuse has also been suggested for Stadion, at the expense of Urban, who is said to have pushed on too quickly, and to have attacked too soon.

The brilliant dashing manner in which Forey, the French general, acted, forms a strong contrast to the measures taken by his opponent. Forey had nothing particular to defend at the spot where his leading battalions stood; and if he had quietly given way before the Austrian columns, until he had fallen back upon the other divisions in his rear, no one could have reproached him with an undue caution. But he preferred to act a more daring part. The feeling of the soldier overcame the caution of the general. He exposed his division to a severe trial, but he led it to a glorious success. Who could be severe on a mistake prompted by a soldier-like courage, even if it entailed defeat? Who can refuse to applaud a boldness justified by the event, and crowned with victory?

At this battle of Montebello, the Austrian brigades were put in a false position, by having to execute an injudicious order, and they were not sufficiently well handled to escape from the consequent difficulties. At the next battle, Palestro, they were again placed in a false position; this time, by having to contend for certain villages against numbers far superior to their own.

On the first day of this battle, it was merely their outposts that were driven out of Palestro, Vinzaglio, and Confienza, places that were quite untenable against such a force as attacked them. Whether it was from neglect of proper precautions to observe the enemy's approach, or from not asking and obtaining from the divisional head-quarters at Robbio orders for the emergency, I cannot say; but it was certainly useless to dispute the places, and there was time enough between the first approach of the Sardinians and the commencement of their attack to get instructions from a place so near as Robbio.

On the second day of the engagement, the Austrians employed a considerable number of troops, but not one-third of the number which the occasion really demanded. Neither Zobel nor Lilia (the two generals who arranged the affair) could have known the total number of the Allies in that neighbourhood; but I think that the number of Sardinian divisions, which had been actually engaged on the previous day, should have made them aware that more than 20,000 men were ready to support the conquests already made. But the Austrians numbered at the outside 18,000, one-half of whom were weakened and disheartened by their repulse of yesterday, and the other half had been hurriedly brought fifteen miles to the scene of action. The number which could be arrayed against them was over 50,000. A battle begun under such circumstances could have but one termination; the line of their attack was also too long for their strength, and so, partly by faults which might have been avoided, partly by the result of the Allies' skill in bringing such a number of men to that place, the Austrians suffered a second defeat.

In reviewing the battle of Magenta, where the Austrians were attacked by the French, you must bear in mind that the position was not deliberately chosen and strengthened, like the heights of the Alma in the Crimean war; it did indeed possess great capabilities for defence, but those capabilities were confined to the line facing San Martino, and from San

Martino no attack was expected, because the bridge had been mined, and was supposed to be destroyed. Hence, the main attack was expected from Turbigo, where it was known that the French had constructed a bridge and established a passage. This will partly explain why the bridges over the canal were not better protected, but will also enhance Gyulai's error in not giving immediate assistance to those troops at Magenta who, without any advantage of position on the north side, towards Turbigo, would have to receive the Allies' attack. The intention of Louis Napoleon was to attack from both places with the nearest available troops (6,500 at Trecate, and 15,000 at Turbigo,) supporting them by 28,000 more as quickly as he could. But with only two roads for their advance, and a river for them to traverse, the arrival of these supporting troops was very liable to be delayed.

The Austrian troops at or close to Magenta numbered 20,000; 11,000 more were between three and four miles off; and 22,000 were near Abbiate Grasso, at about six miles distant.

Generalizing from these situations on the Austrian side, we may say that if the troops at Magenta, Corbetta, and Robecco could maintain themselves until those near Abbiate Grasso arrived on the field, the victory would probably be theirs. And that, if the troops near Abbiate Grasso were put in motion as soon as the signs of a battle were observed, they ought to arrive soon after it had actually commenced. Observe the result. Gyulai received, at Abbiate Grasso, an official report, about 8 A.M., that the enemy threatened an attack, but none of the troops close around him reached the field before 5 P.M. The serious injury caused by this delay was not likely to be redeemed by the method of bringing the troops into action. They came indeed from a formidable point, on the French flank, but the brigades were injudiciously led against the enemy, one after another, instead of being collected and employed in one mass.

Also, some marched along the east side and some along the west side of the canal, so that mutual support of one another was impossible. Perhaps, however, Gyulai was not informed that the bridge at Ponte Vecchio was destroyed. And it is very possible that he was not informed, for he had ridden away to Robecco after spending half an hour at Magenta, and I cannot make out that he ever returned. A letter from the "Times" correspondent at Vienna, many a month afterwards, retailed some remarks in circulation about Gyulai's conduct here which I do not care to repeat; but they corroborate the conclusion I draw from other sources, that he did not resume his proper post.

Now, apply such a case to other battles. Imagine Buonaparte at Marengo leaving the field to show Dessaix the best road for his march. Imagine the Hero of Waterloo—the Iron Duke—imagine him choosing to go and meet Blucher rather than to study with his own eye the progress of the battle, and reassure by his calm presence the struggling British regiments. Hear what Sir Charles Napier says about the Battle of Meeanee:—"Had I left the front one moment, the battle would have been lost; but, had I not been there, some other would have done the same." We might add to this, "and some others would *not* have done the same." Gyulai may have been so hampered by the Imperial Cabinet that he was hardly a free agent in his strategy; but our sympathy with his embarrassments, and our patience with his errors, can hardly survive this exhibition

on the day of battle. It seems to me that a general who, in addition to previous mistakes, remains inactive for hours after hearing that a battle is at hand—who limits his presence at the scene of action to one half-hour, and who then rides three miles away, is beyond all apology or excuse.

It is disagreeable for me to speak hardly of any officer so high in command; it is with pain that I criticise so harshly his conduct; but I could not undertake to explain the causes which led to the reverses of the Austrians without exposing the failings of their commander-in-chief. I appreciate at their full value the difficulties of such a situation, and I confess that, in Shakespeare's words, "I had rather teach twenty what were good to be done, than be one of the twenty to follow my own teaching." But we can hardly over-estimate the influence which an able commander-in-chief might have exercised on the Austrian fortunes, when that morning of the 4th June broke on the hostile armies at Magenta.

The arrangements of the Allies had been formed on the supposition that no strong force was ready to oppose them, and that any troops which might arrive in the afternoon would be overcome with the fatigue of a long march, whereas a delay of twenty-four hours would suffice to make the enemy's numbers important, and to make the position behind the canal impregnable. "Let us strike the iron" said Louis Napoleon, "while it is hot; to-morrow our situation will be less advantageous." He intentionally let the attack from San Martino become evident early in the day, that the enemy might form a line along the canal, with its flank directed towards M'Mahon at Turbigo. The attack from San Martino, when begun, was only to engage the intention of the Austrians, and expose them to an easy and certain defeat from the other direction.

But I venture to suggest, that it was presuming too much on the short-sightedness of the Austrians to suppose they would adopt such measures. The Austrians believed they had prevented the Ticino being crossed at San Martino by blowing up the bridge, whereas they knew to their cost, by the experience of a slight defeat, and the loss of a gun, on the 3rd June, that the French had constructed military bridges at Turbigo, and had already crossed over there in some numbers. Louis Napoleon must have felt that the Austrians could not remain ignorant of such a passage having been effected when this encounter took place, and, with this fact before them, was it likely that they would allow their attention to be fixed on San Martino, and diverted from Turbigo? Was it likely that they would place the mass of their troops in a line facing San Martino, behind such an important obstacle as the great canal, and leave their flank open towards Turbigo, where there was no natural defence, and where the enemy was known to be already on the east side of the Ticino? It seems beyond all probability that the Austrians would take such a course; the chances of their doing so were so remote, that it would be injudicious to stake much on the event.

However, if there was only one incomplete *corps d'armée* to defend the position (and Louis Napoleon had every reason to suppose this was the case), he risked little or nothing by the order of battle which he selected. M'Mahon, attacking from Turbigo, would at least be able to hold his ground until the Piedmontese came to his assistance, and a diversion from San Martino would greatly diminish the opposition to his advance, if it did not have all the effect which a sanguine imagination sketched out for it.

But if there were more than one incomplete *corps d'armée* to defend Magenta—if, in spite of all appearances, there should prove available a more numerous force on the Austrian part than any which the Allies could display in the first few hours of the battle (and we know now that it was so), then Louis Napoleon's arrangements would prove dangerous in the extreme.

If M'Mahon were beaten, and pursued by the enemy, he would never be able to retire over the Turbigo bridge, encumbered as it was with men and baggage coming the opposite way; and, with no retreat open, his *corps d'armée*, if beaten, would be annihilated; no assistance could reach him from the San Martino side until a passage had been forced over the canal; and, if the bridges were well defended, the gaining a passage was impossible.

The arrangements with M'Mahon led to the Imperial Guard going into action before any support was in sight, and exposed it to the risk of being driven back to San Martino before the reserve was ready to cover its retreat. Any obstruction would have been as fatal there as at Turbigo. Nothing can be more dangerous than for an army to begin an action, as the French did at Magenta, with a couple of bridges for their only retreat, and both those bridges crowded with baggage and camp followers, as bridges must, under such circumstances, be.

To discuss the arrangements which would have been the most judicious to adopt on either side, is not within the limits of my time, nor does it form a necessary part of the question we have to solve; suffice it to say that, taking things as they were, if Gyulai had only brought up the distant troops with proper rapidity, he would have had 50,000 men on the ground at a time when the French had only 35,000; and the victory, which seemed ready to turn in his favour about three o'clock, must, in all human probability, have been secured to him. A certain German writer on the campaign, a military man, who makes the most of the Austrian case, and who speaks of Gyulai as more unfortunate than incapable—"*mehr für unglücklich als für kurzsichtig*"—admits that he failed to display, on this occasion, the ability which he had the credit of possessing.

This was Louis Napoleon's first battle—his first opportunity for realising those ideas which must in the years of his private life, and during many a weary hour of captivity, have revolved in his mind. You may read how Sir Charles Napier, when he found himself unexpectedly in command of an army, was ready at once to act on principles which his service as a regimental officer in the field and his active genius at home had impressed upon his mind. With these principles clearly before him, and the example of our great Duke to guide him in their application, he only wanted the opportunity, which came in his old age, to crown his soldier's career with a general's glory. So I can imagine Louis Napoleon eager for the day when he should try his strength, and ascertain how far he could realise in practice his own ideas of a skilful commander.

The course of this first battle must have severely tried his self-command. The chances to which he trusted had failed him. They were in favour of his finding the Austrian army at Magenta weak in numbers, and incapable of resisting a double attack; but the Austrian army proved to be more numerous than his own, and the intended result nearly recoiled on himself. Intense anxiety about the event, and mortification at having been misled into such an attack, must have embittered his whole day. Even when

night fell he could not tell how long he should be able to maintain the ground he had won. Nor could his anxiety have ceased till the following morning, when the Austrians' retreat silently acknowledged they could no longer dispute the victory.

But if you think the reasons on which he acted were insufficient to justify his form of attack, and, arguing from this battle, doubt his ability as a commander, look at the skilful manner in which the flank march from Voghera to Novara was executed. Look at the careful way in which he led the allied armies over the country between Magenta and the Mincio. Look at the coolness with which he surveyed the line of Solferino, the judgment with which he selected its most vulnerable point, and the decision with which he carried out his plan. Then, consider that he commanded an army now for the first time; consider also how great an army that was, and how serious a stake he had upon the event, and say, if you can, which of his mistakes are to prevent our awarding him the admiration and honour due to a distinguished military chief.

"We cannot figure to ourselves," says Major Lecomte, a staff officer in the Swiss army, "we cannot conceive any human situation more serious than that of a sovereign called upon to give a decisive order under such circumstances." Let me just recall those circumstances to your minds. The Allies, having broken up their bivouacs at two in the morning, to avoid the great heat of the day, were marching easily along seven different roads towards the Mincio, in the belief that the Austrian army was posted along that river. Unexpectedly they came at daybreak upon a long line of outposts—a line gigantic in its extent—the attack of which called forth masses of troops in corresponding numbers. The smoke of the artillery began to hang over the field before the morning mist had well cleared off. With no information of the enemy's force, no means of getting a perfect knowledge of the position, and no time to supply these deficiencies, it required a practical ability, and a decision of character granted to few men, to do as Louis Napoleon did.

It was unfortunate for the Emperor of Austria that he should meet on his first battle-field so formidable an antagonist. The peculiar circumstances of the case lessened his chance of sustaining a comparison with his rival chief and emperor. If ever there was a crisis in war which required coolness, experience, and unity of command, it was that when the Austrian army, 150,000 strong, suddenly found itself attacked along a front of 11 miles by so energetic an enemy. To expect more from the young emperor than that he should encourage the men by exposing his own person to peril, and stimulate their loyalty to increased efforts by showing his own contempt for danger—to expect, I say, more than this, would be unjust towards his youth and his inexperience. There is the testimony of eye-witnesses to his performing this part well; therefore let us not ascribe to him any further responsibility for the defeat.

How far Count Hess, his military adviser, was responsible, I am not prepared to say. It has been asserted that Hess was so opposed to the general design that he would not draw up the details, and kept aloof from their execution. The neglect of ascertaining by reconnoitring parties on the 23rd what positions the Allies then held, reflects badly on the general staff arrangements. It seems, as I said in the first lecture, to have been taken

for granted that the Allies could not be anywhere but along both sides of the Chiese; and the absence of all preparation for a battle, if it should be unexpectedly necessary to fight one, indicates that the details and difficulties of the march from the Mincio had not been sufficiently considered.

All that the commanders of the separate *corps d'armée* could do when they found themselves committed to a battle, for which they had no instructions, was to deploy their divisions and hold their own ground until particular orders were received from the imperial staff.

By an unfortunate misunderstanding, the officers of the staff, 60 or 70 in number, were all separated from the Emperor during half the morning; and this accident, arising apparently out of the confusion of the attack, must have been a serious hindrance to the proper handling of the army. The staff left Valeggio (eight miles from Solferino) at six in the morning. The Emperor, accompanied by Hess, was to follow at half-past seven. As the staff entered Cavriana, hospital waggons began to arrive from the front with loads of wounded men. Further on, an orderly met them with a report that the battle was general along the whole line. Soon the masses of infantry stretching across the plain from Solferino to Castel Goffredo, partly hidden by the curling smoke of the guns, displayed to the officers' own eyes a great part of the encounter, and the distant firing towards Madonna della Scoperta and San Martino indicated that it extended in that direction.

Impatiently they wait for the Emperor to arrive and assume the direction of affairs. Anxiously they inquire and wonder where he can possibly be. At half-past eight a message is brought that they are to join him at Volta. They get there at nine, but he is gone across the country towards Cavriana. Riding across the country after him, as if they were riding to hounds, occasionally stopping to try and obtain some information about him, they join him at last in the neighbourhood of that village.

It was not till after Solferino was taken that measures were prepared for attacking the Allies with a definite object. The fourth French corps, Niel's, appeared rather isolated from the others in the plain. On this corps the left wing, assisted by the reserve, was to make a decided attack. But here the bad organization of the Austrian army verified the objections to which it was open. There was no reserve under the Emperor's own orders; consequently there was none on the use of which he could rely. There was a reserve to each wing; but even on the left wing, which was less pressed than the other, all the reserve brigades, except one, had already been employed.

And this difficulty was the natural result of the army being so divided into two wings, each under a particular general. If Counts Schlick and Wimpffen, who commanded them, did nothing without orders from the Emperor, they were mere ciphers—or worse, because the transmission of orders through them would create unnecessary delay. If they acted independently of him, it was only too probable that he would be disappointed (as he was) in finding any of their divisions available for executing the manœuvres he himself had planned.

And now, if you turn your attention to San Martino, where Benedek fought an almost separate battle with the Sardinians, you will see the characteristics in the leadership of the hostile armies exactly reversed—counterchanged from one side to the other, as two colours are counterchanged on a heraldic shield.

Benedek had his men in a good order of battle, with reserves ready for application at the right moment. The Sardinians were scattered over some miles of ground between San Martino and Lonato. Their brigades hurried up independently, stormed the heights as they arrived, and were thrown back again and again. Like the stone of Sisyphus, they all but crowned the ascent each time; like it, they rolled back as often. But they differed from it in this: that they were not urged on by an avenging fate or an irresistible decree; it was injudicious management, or want of superior control, which caused the misapplication of their force. Victor Emmanuel had shown himself a brave soldier at Palestro, but he did not develope the qualities of a general at San Martino.

Before quitting this part of the subject, let me caution you against the impression that the Austrian army was strongly posted on this 24th June. Certain strong points were presented by the village of Solferino itself, but they were accompanied by many defects; and, after all, the vicinity of Solferino was but one-eighth part of their line—bearing about the same proportion to the whole as this desk bears to the table on which it stands. The view of Solferino from below gives the impression of strength; a near examination of the ground brings its weakness to light. Both views are taken in exaggeration by two different writers in the "Times," one of whom exalts it into a "hill fort," than which "it is impossible to imagine anything stronger;" and the other abases it into "a bad position for defence."

The cemetery and the convent were strong places for infantry to hold, and there were some excellent positions for guns. But the slopes were so steep, and the ridge across (not along) which they stood was so narrow, that the movements of the Austrian infantry were impeded, artillery were almost restricted to the posts on which they were first placed, and cavalry could not be used at all. The cemetery could be battered from a distance; the steep slopes could be escaladed by a rush of infantry without any fear of cavalry dashing in upon them; and the artillery must either cease firing before the enemy came close, or run the risk of being captured in the awkward roads by which they had to retire. So the position, which does appear to the first glance nearly impregnable, discovers elements of weakness which all but, if not quite, counterbalance its strength; and there was no time to remedy the former or to increase the latter.

To the defection of those sixteen squadrons of cavalry which were taken off the field by General Lauingen without orders, I do not ascribe any great influence on the result of the battle. I believe they would have added considerably to Niel's embarrassment, but would not have turned the scale of victory against him. Besides, the Austrians must have gained a very great success in the plain to recover the honours of the day when Solferino was lost; and I cannot think that the presence of these cavalry would have secured such a result.

Much more influence must be attributed to the French rifled cannon, which here, for the first time, were able to exhibit their superiority over the old smooth-bored field-pieces. At Magenta the closeness of the trees and vineyards had reduced their share in the battle to so low a point, that the French artillery had there only 22 men killed and wounded. Here, the artillery in Niel's corps alone had 77 killed and wounded; and, if we may

judge from this criterion—and it is not a bad one—artillery played a part seven times greater at Solferino than at Magenta.

The superiority of the rifled guns told both in accuracy of fire and in length of range: in length of range, by the shots which were fired at so high an elevation as to pass over the first lines of troops, falling with deadly effect upon the reserves in rear; in accuracy, by disabling the Austrian guns almost as fast as they came into action. The "Times" correspondent describes a battery of Austrian horse artillery having five of its guns dismounted at 1,700 yards distance; another battery came forward to assist it, and had three guns disabled in one minute. Mensdorf's cavalry had 500 horses injured by the same means.

And yet I must remark that one feat of the French artillery in this battle, a feat to which their historians refer with admiration, seems a clear instance of the great difference there is between the performance of a gun on the practice ground and its actual effect in a battle. When the cemetery on the Solferino ridge was found to resist the assaults of the French infantry, the artillery was ordered to breach it. To do this a battery took a position 250 yards from its walls, and the coolness with which a fire was directed to making a breach from that dangerous position is highly praised by the despatches. But if the gun would hit with certainty a man on horseback at one mile and a quarter (as was declared), it could surely hit a wall ten feet high without approaching to 250 yards. And neither the strength of the wall nor the formation of the ground appeared to my eyes to make so close an approach necessary.

In addition to this, the walls, properly so called, were not breached after all—at least not sufficiently so as to admit a storming party. Holes were made such as you may see on this drawing, which I copied from a sketch of my own, made on the spot before the walls were repaired; but I apprehend that the breach means that the gates on that side were knocked down, and perhaps some loose stuff displaced, which may have been hurriedly piled up between the pillars to form better protection for the men inside.

Now, when people hear that guns are adopted which will carry 1,000 or 1,500 yards with accuracy, they are apt to infer that artillery will never again be used at shorter distances. No professional artillerist would admit such a conclusion, but the above incident is a good example of its falsity. The power and precision of these guns was sufficiently proved elsewhere; but here they had to be brought close, from reasons caused by the exigencies of the battle.

You may imagine that I, as an artillery officer, looked with particular interest for such authentic details as would illustrate the power of these rifled guns. I will not pretend to have exhausted all the sources of information, but I have gone over a vast deal of printed matter, I have received a little personal information, and I have visited the spots where the guns were used. Yet the foregoing incidents represent all the facts on which I can rely. The "magnificent results" vaguely mentioned in newspaper letters cannot be sufficiently identified; they are generally denied by the opposite party, and add nothing to the knowledge of details which we require to form our judgment of the effect really produced.

In the battles preceding Solferino, long ranges were positively unattain-

able, and one advantage of the new cannon was thereby lost. This, however, will be the case in many an action. At present I see no reason to suppose that rifled artillery will ever pour forth a fire so sweeping and so murderous that troops at a distance will be scattered by it, at least under ordinary circumstances. If the power of cannon is increased since the last great wars, so is that of small arms. The time is not yet come for converting infantry into artillery, and the quickness combined with the weight of horses must always render the presence of cavalry important.

To estimate the changes which the improvement of fire-arms has caused in the relative values of artillery, cavalry, and infantry, is a difficult thing; but I believe that each arm of the service will always retain its distinct and indispensable function in battles—artillery to weaken from a distance the enemy's ranks, cavalry to impede his movements, and infantry to decide the contest at close quarters. It is only in exceptional cases that I can imagine artillery settling the issue of an engagement independently of a serious musketry fire, or an appeal to the bayonet's point.

Now, in every battle there comes a period when generalship is of no more avail—when it is left for stoutness of heart and steadiness of hand to finish the work which generalship has begun. The skill of the commander is evinced by bringing up his men in the manner best calculated to secure victory; but victory depends finally on qualities which are not at his disposal. Some races possess such energy and endurance that they refuse to know when they are beaten, and resist superior numbers with such pertinacity that the best generalship is baffled by their resolution. Let us then inquire how the generalship here was aided by the vigour, or embarrassed by the faint-heartedness, of the men, and examine what influence the fighting qualities of the soldiers had on the battles in this campaign.

"It is unnecessary to describe," says Sir Wm. Napier, "the first burst of French soldiers. It is well known with what gallantry the officers lead, with what vehemence the troops follow." This passage occurs in his "History of the Peninsular War." The same qualities had been remarked by a chronicler three centuries before, and they were manifested to their full extent in 1859.

Then comes the question, "How were these attacks met by the other side? Dashing as they are, and terrible as they are, we can point to many a record of their having been made in vain. What manner of resistance did they experience on this occasion?" The question is not so easily answered. The details on such points are incomplete, and the broad facts difficult to determine, because the statements of either side must be received with caution. When the victorious party declares that its men showed heroic courage, and had to contend against superior numbers, we accept the statement with some deduction from the strength of the language. But if the defeated party likewise declares that its own men fought with heroic courage, and also had to contend against superior numbers, we cannot accept both statements at once. Language such as this was used by the Austrians and by the Allies after each engagement. There is, however, one test by which such statements may be tried—that of comparative numbers. If the soldiers on either side failed to hold their ground against a similar number, or only won

their success by being superior in number, I do not see how their claim to heroic bravery is to be maintained. Let us apply that test to the encounters in Italy.

At Palestro the Austrians were outnumbered to such a degree that success would have been almost miraculous. At Malegnano, where their rear-guard was attacked by two French *corps d'armée*, a similar disproportion existed; at both, and especially the latter, the performance of the men is sufficiently creditable to spare us the trouble of closer inspection; we have therefore only to examine Montebello, Magenta, and Solferino.

On the extreme right of the Austrians at Montebello, a brigade commanded by the Prince of Hesse met a portion of the French at Oriolo. The prince had three battalions in his own brigade, and was reinforced by one of those under General Bils. If we calculate his force at 4,500 men, we must estimate the French (who had only two battalions) at 1,500 men; mere trifling skirmishes took place between them, and perhaps the peculiar circumstances of the case prevented the prince from attempting more. His distinguished conduct at Solferino puts all imputation on him out of the question; but I mention the incident, because it is an example of the manner in which prejudiced writers describe every event. The German officer to whom I have before referred, gives his readers to understand that the prince showed devoted courage and judicious circumspection (*aufopfernde Tapferkeit, kluge Umsicht*); and that the men, overmatched by the enemy, displayed an invincible bravery (*unübertroffene Tapferkeit*).

But, whether the brigade under the Prince of Hesse put forth all its strength or not, there is no doubt that those at Montebello did, when Forey attacked them there; ten battalions held the village when Forey stormed it with his single division, incomplete in its number of battalions, and still more incomplete in the strength of its companies. If we calculate the Austrians according to the strength which they confessed to at Magenta, they must have been 8,000 bayonets; yet Forey has lately declared upon his honour that he had only 4,000 men under fire that day, and he has explained the cause of there being so few. So the Austrians were beaten by half their own number.

This result is rather startling; but you will see it is only in accordance with what occurred afterwards at Magenta. Eleven battalions of the Imperial Guard were sent to gain possession of the bridges over the Great Canal. After crossing a plain swept for some distance by the fire from the heights which commanded the approach, the guard had to storm a position well calculated to help out any inferiority of numbers on the defenders' part, if inferiority there was. But these eleven battalions found the bridges defended by at least three full brigades, who had had all the forenoon available to strengthen their posts and complete their arrangements.

To each brigade in this battle the Austrians assign from 3,500 to 4,000 men, instead of 6,000. Reduce the French battalions in the same ratio, and you will see they had only 6,500 bayonets opposed to nearly 11,000. Yet they gained important successes, and were never quite driven out of the places they won. Reinforcements as they came up turned the scale of numbers on either side alternately, but the French gained something new each time; the Austrians never recovered all they lost.

On the side of Magenta towards Turbigo, M'Mahon was superior to the Austrians. So also, at Solferino, Louis Napoleon managed to mass upon the centre such a number of men as was likely to outweigh all opposition. In both instances the required effect was attained, and that almost without employing some considerable portion of the force. But the concentration of the French reserve (the Imperial Guard) entirely on the centre at Solferino caused that portion of the line where Niel was posted to be comparatively weak. Canrobert's extreme care about a reported flank attack made the line even weaker than it need have been, and the Austrians had in this battle, as in each of the others, a favourable opportunity, which they failed to seize.

That they held their ground at San Martino must be in a great measure, if not entirely, ascribed to Benedek's generalship. By his arrangements there was a reserve ready to support them when the Sardinian soldiers, fewer than they, had driven them to the last point of their position. Had the Sardinians been equal in numbers and equally well handled, it is probable the result would have been favourable to them.

Now, observe the great difference in number between the French and Austrians at Montebello, and again at the Great Canal. I insist upon these cases more than the one at Solferino, because the difference existed before the fighting began, and did not result from the arrival of reserves during the engagement. Moreover, difference of number tries the courage of the men more in small forces than in large—tries it more when 2,000 are opposed to 3,000 than 20,000 to 30,000. And how are we to get over the testimony of these figures? I cannot conceive them to be so wrong as to influence the general comparison; but there is yet one other way in which we may test the endurance on either side, without being seduced by the flow of language or the magniloquent epithets of prejudiced authors.

We must see whether the losses suffered by the Austrians indicate very determined resistance. If so, we may yet attribute their repulses to causes over which the private soldiers had no control. It is a painful task to study lists of killed and wounded with the sole object of drawing statistical conclusions from their records; but I wish to leave no point unexamined which may help to determine the question fairly for both sides.

When the 1st Regiment of Zouaves stormed the barricades at Malegnano, it had one-third of its strength disabled. When the Piedmontese brigades struggled to win the heights of San Martino, they cheerfully came to the charge a third and a fourth time, although their losses were amounting to one-seventh of their number. The grenadier division of the Imperial Guard, which carried and held the canal bridges at Magenta, lost one-eighth of its force. Niel's corps, on the 24th of June, kept pressing on towards Guidizzolo, in spite of one-seventh of its men falling victims to the effort. I take these as examples of the perils and difficulties which did not prevent the allied soldiers from still obeying orders, and still presenting a firm front. And now, if you examine similar records on the other side, you will see that the first and second Austrian *corps d'armée*, which were so disorganized at Magenta that they abandoned the field and were utterly unavailable for duty on the following day, had lost but one-eighth and one-twelfth of their men respectively.

And you may also see that, of those three *corps d'armée* which failed to drive Niel's single corps out of Rebecco on the 24th of June, not one suffered so severely as their victorious opponents. It is not worth while to give further details, for none can be brought forward which will show that they had superior endurance to compensate for inferior dash or energy.

Now, when we consider that the 8,000 British troops who were suddenly called upon to defend the heights of Inkermann against overwhelming numbers, and who had no advantages of ground or artificial defence in their favour, stood firmly whilst the gaps in their ranks widened and widened until they had swallowed up nearly one-third of the defenders' small force, we must protest against the highest terms of language being applied to men who were driven to retreat and thrown into helpless disorder by half the cause.

The vehemence of the French attacks may have been sometimes checked by the Austrians. Particular points—such as the cemetery at Montebello, the outskirts of Magenta, and the ridge of Solferino—may have been gallantly contested; but, sooner or later, the same result followed every collision between the two nations, and evinced the disparity between their fighting powers.

And, now that the dull testimony of figures has relieved the brilliancy of eloquent accounts, one or two subdued remarks, which may have previously escaped our dazzled notice, will assume more distinctness in our eyes. "It is whispered," writes a correspondent from Vienna, "that the soldiers of the first and second corps at Solferino had lost all confidence in their commanders; in fact, some of the brigades could not be induced to march to the front." "I was astonished," another correspondent writes, "to see men from the field of Solferino retiring unwounded, and lying down exhausted when out of reach of the enemy's fire." Other paragraphs of similar tone are to be met with here and there. Even an Austrian officer of rank confessed the inferiority of their infantry in one respect. "Our brave fellows," he said, "had not quickness enough; they stood up to be shot at." This criticism, however complimentary to their passive resistance, is most damaging to their general reputation. Soldiers without activity are useless, and their presence in the field is a mere sacrifice.

Bad supplies of food, in addition to a bad system of feeding, did, I have no doubt, bring the men hungry into action at Solferino and Palestro, and lessen their physical powers. At Magenta the fatigue of a forced march was likewise urged in their favour; but on that ground the Allies might also claim consideration. They had marched many miles in the few days preceding the battle, and on the morning of the battle most of their divisions had to march a greater distance to the scene of action than those Austrian corps which they defeated. The weight which the men had to carry was also complained of, and, to relieve this, the Emperor ordered the men's knapsacks should be carried for them. Certainly, the weight of accoutrements and necessaries should be reduced to the lowest possible scale; but a soldier who cannot carry them is not an efficient infantry soldier at all, and, when a man's necessaries are once separated from him, any delay in re-issuing them is likely to be more injurious than

the fatigue of carrying them. Moreover, if want of transport had any share, as it must have had, in causing the bad supplies of food, the increased demand for animals and carts to carry the knapsacks would make the evil far worse.

Lastly, and to this I attach more importance than to any other excuses or explanations, the Austrian army had just then a great proportion of young raw soldiers; and the variety of the nationalities from whom they were recruited prevented their being animated by one and the same spirit. Hungarians, Poles, Croats, Germans, and Italians, composed different regiments; each race having its own peculiar affection, and each repudiating the name of Austrian. The difference went so far that it became positive disaffection; and, though the government papers denied the reports, it was asserted that at Magenta one battalion of Jägers surrendered at discretion; that many of an Italian regiment allowed themselves to be taken prisoners the same day; and that the Croats were not to be depended upon at Solferino.

If the combativeness of the Austrian soldiers does not bear a searching scrutiny so well as I hoped, I am bound to say that the French bear it better than I expected. They seem not only to have attacked with their usual vehemence on every occasion, but also to have sustained the counter-attacks with more enduring steadiness than they usually show. And an impression, which perhaps you may have received (as I received), that the Zouaves and other picked troops were always sent to the front when anything serious was attempted, will vanish when you become acquainted with the organization of their brigades, and the formation of each at the moment of action.

The Sardinians' demeanour at the battle of San Martino justified the expectations which were founded on their soldier-like bearing and military habits; but in no other action was their gallantry much tried, except in those cavalry charges at Montebello, which did honour to the squadrons who made them.

So we have considered, as closely as time would allow, in what degree each side exhibited the qualities on which victory and defeat most closely depend.

And now, concentrating these remarks on the question before us—"What caused the result of the campaign?"—I submit that in strategy little advantage was gained on either side; and, with regard to the battles, that the inferior engagements of Montebello, Palestro, and Malegnano, were only important so far as they affected the moral tone of the soldiers in the opposing armies. The fate of the campaign hung on the battles of Magenta and Solferino, both of which were begun under auspices as favourable to the Austrians as to the Allies. At the former battle, Gyulai's slowness in bringing up to the field the troops at a distance from it, prevented the reinforcements from producing the effect which might otherwise have been expected. At the latter battle, there was no one on the Austrian side so favoured with the great gift of practical military genius as to remedy the embarrassment caused by the unexpected encounter, and to direct with judgment the unpremeditated movements of 150,000 men. There were no troops to execute the commander-in-chief's own orders when they were wanted, owing to the objectionable division of his army

into two separate independent wings, and the enemy's rifled artillery made gaps in the reserve brigades before the time was come to employ them.

Lastly, it must be mentioned that the private soldiers of the Austrian army showed themselves unequal to sustain the dashing attacks of the French. Better men might have brought each battle to a different end. This may have been partly due to disaffection, and partly to bad commissariat arrangements, which brought them hungry into action. But, from whatever cause, the Austrian soldiers were not able to maintain their ground against the French infantry, far less were they equal to redeeming, as soldiers have before now redeemed, the mistakes or oversights of their generals.

If I had to express in the fewest possible words what caused the Austrians' reverses in this campaign, I should attribute them to inferiority (compared with their principal antagonists, the French) in the following points:—

Principally	In handling of the troops in action, and in the fighting qualities of their soldiers.
Subordinately	In the working of their commissariat and in organization of their army.

In these lectures I have tried to compress into a few words the account and review of many exciting events. The brief sketch which I have produced bears the same relation to the capabilities of the subject as the dry little books of history which we read at school bear to the interesting works which we take up in after years. I, remembering that those dull little books gave me a distaste to history for many a year afterwards, was afraid that my meagre description would put the campaign in a very uninteresting light. But, from the kind attention with which you have listened to me, I am induced to hope that the lectures have not fallen wearily on your ears. I am induced to hope that my sincere efforts to do justice to the subject, and to produce a lecture worthy of the Royal United Service Institution, have not been made in vain; and, finally, to trust that this imperfect abstract will lead you to a further study of the Campaign of 1859.

Friday, May 24th, 1861.

Col. P. J. YORKE, F.R.S. in the Chair.

THE TRAJECTORY OF BALLS.

By Major-General P. ANSTRUTHER, C.B., H.M. Madras Artillery.

PREFACE.

Extract from "Straith's Memoir of Artillery," pp. 81, 82: "Dr. Gregory, in his Lectures upon Gunnery, observes, on the difference between the times employed by a ball in ascending and descending vertically through the same space: If a 24-pound iron ball were projected vertically upwards, with a velocity of 2000 feet per second, it would ascend to the height of 6424 feet before its upward motion was extinguished, and it would pass over that space in less than $9\frac{1}{2}$ seconds. (This is computed in 'Hutton's Mathematics,' vol. 3.) It might, on a cursory view of the subject, be supposed that the circumstances of the descent would be analogous to those of the ascent, but in an inverted order: and so they would in a non-resisting medium; but in the air the case is widely different. After the ball had descended 2700 feet, the resistance of the air would be equal to the weight of the ball, there would remain no further cause of acceleration, and the ball would descend uniformly with its *terminal* velocity (that is, the greatest velocity which a heavy body can acquire when falling in the air), which does not exceed 419 feet per second. It would require, therefore, $\frac{6424 - 2700}{419}$, or 6 seconds, to descend the remaining 3724 feet, in addition to the time, about 10 seconds, which had been occupied in descending through the first 2700 feet; so that, in this instance, the time of descent would be about double that of ascent. In all cases where the projectile velocity exceeds 300 or 400 feet, the time of descent will exceed that of ascent; and their difference is greater the more the initial velocity exceeds that limit."

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1. As we are unable to procure a copy of Dr. Gregory's Lectures on Gunnery, we must content ourselves with an extract, quoted from Hector Straith's Memoir on Artillery, *vide* Preface.

Speaking of a ball fired vertically upwards, he says, after detailing the particulars of the initial velocity, time of flight, &c. &c. "so that, in this case, the time of descent would be about double that of ascent."

2. These are the words of a professor at the Military Seminary of Addiscombe, quoting those of the Professor of Mathematics at the Royal Military Academy of Woolwich; we may therefore safely infer that this was what the greater portion of Her Majesty's Artillery learned as part of the science of gunnery.

3. Believing that, as in the case supposed above, so in any case of a ball's being fired upwards, the time of ascent and the time of descent must of necessity be exactly equal, it is obviously our imperative duty to protest in the most public manner in our power against the continued training up of our young officers in a course of error.

4. By the first law of motion we learn that "A body in motion, not acted upon by any external force, will move in a straight line and with a uniform velocity."

Suppose a 24-pound iron ball projected vertically upwards with velocity V, it would, in any time T, ascend in a straight line to a distance equal to T V, the number of feet per second denoted by V multiplied by the number of seconds denoted by T, if it were not acted upon by any external force whatever. Let A X represent a horizontal plane, and suppose the 24-pounder gun placed at A and fired vertically upwards, the ball would, in the time T, go vertically upwards to a distance eqnal to T V; let the line A Z forming a right angle with A X represent the measure and direction of the path of the ball if not acted upon by any external force.

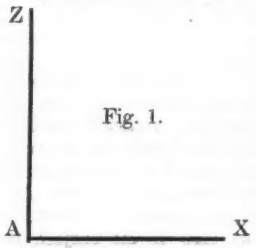


Fig. 1.

5. But the ball does not go from A to Z in the time T; it is seen to go part of the way and to return, striking the plane A X at the expiry of the time T. Dr. Gregory gives for the time of ascent "less than 9·5 seconds," and he gives a time of "about 10 seconds" for one part of the descent, and another of "6 seconds" for the other part of the descent; a total of 25·5 seconds for the whole time of flight of this 24-pound ball fired vertically upwards.

6. It follows, therefore, that the ball has been acted upon by some external force during its time of flight, and a very short reflection gives us the certainty that it has been acted upon by two, and only two, external forces; these are,

1. The resistance of the atmosphere, and,
2. The force of gravity.

These two we shall consider separately.

7. The first of the two, the resistance of the atmosphere, can only act by diminishing the length of A Z; it cannot take it out of the line of direction given to it, nor can this force in any degree whatever tend to bring the ball back to A, as we see the ball does come back in 25·5 seconds. Therefore there is, somewhere or other on the line A Z, a point Y, at which the ball would have arrived in the time 25·5 seconds if acted upon by no other external force, but by this force alone; the portion of A Z which is between Z and Y is the measure of the retardation produced by the resistance of the atmosphere.

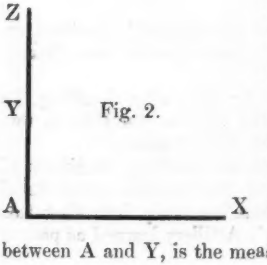


Fig. 2.

8. The remaining portion of A Z, which is between A and Y, is the measure of the effect of the force of gravity upon

this ball in motion from A towards Z during 25·5 seconds of time, and we proceed to consider this with the assistance of the second law of motion, from which we learn, that, "When any force acts upon a body in motion, the change of motion which it produces is the same in magnitude and direction as the effect of the force upon the body at rest." That is to say, when the force of gravity alone acts upon this 24-pound ball in motion from A towards Y, the change of motion which it produces is the same in magnitude and direction as the effect of the force of gravity upon the 24-pound ball at rest.

9. Now what is the effect of the force of gravity upon a 24-pound ball suffered to fall from a state of rest, during the given time, 25·5 seconds? What is the fall by gravity during 25·5 seconds? We can answer this readily; it is $25{\cdot}5^2 \times 13{\cdot}75 = 8940{\cdot}9375$ feet, say 8941 feet. Dr. Gregory seems to have thought that the ball was not opposed by gravity until it had culminated; but this is evidently an error. The ball will fall by gravity, from a state of rest, through 8941 feet in 25·5 seconds of time, acquiring thereby velocity V; therefore this is the exact measure of the height to which it would have ascended in 25·5 seconds of time, if fired with initial velocity V, and if not opposed by gravity. We must therefore now determine the value of V, which is not difficult.

10. If we deduct the fall for 25·49 seconds from that for 25·50, the difference will give the space described by the ball in the last hundredth part of a second of its fall. It is as follows, viz.:—

25·50 seconds, $25{\cdot}50^2 \times 13{\cdot}750 = 8940{\cdot}9375000$ feet.
25·49 ,, $25{\cdot}49^2 \times 13{\cdot}751 = 8934{\cdot}5761151$ feet.
A difference of 0·01 seconds and 6·3613849 feet,
Showing a velocity of 636·13849 feet per second = V.

11. If an initial velocity of 2000 feet is required to give 25·5 seconds time of flight to a ball fired vertically upwards, an initial velocity of $2000 \surd 2$ must be necessary to give the same ball at 45° elevation the same time of flight, so that to range at 45°, with 25·5 seconds of flight, the initial velocity must be 2828·4. Now Sir Howard Douglas tells us that at Landguard Fort (in 1806) the shell of 200lbs. with a charge of 10lbs. did range 2960 yards in 25·3 seconds at 45° elevation. Did a charge of one-tenth of the shot's weight give a velocity of 2828·4 feet per second? Our calculation makes the range twenty yards longer in three-tenths of a second more time, and the velocity $636{\cdot}1385 \surd 2$ or 900 feet per second. Is the velocity gained by using a charge of one-tenth of the shot's weight more likely to be 2828 feet, or 900 feet?

12. The Washington experiments, p. 47, prove that with a long gun, 32-pounder, the velocities gained were, with

0·333	of the shot's	weight,	1691	feet	per second.
0·25	,,	,,	1570	,,	,,
0·2	,,	,,	1462	,,	,,
0·166	,,	,,	1396	,,	,,
0·125	,,	,,	1218	,,	,,

Ours of 0·1 may be correct, as 900; but how can Dr. Gregory's of 2828?

13. Will any amount of powder give any cast-iron ball a velocity of 2828, or even of 2000 feet? The French table given in page 429 of the

Aide-Mémoire gives velocity 1798, 1794, and 1732, as the result of half the shot's weight, and the experiments show that a further increase of charge would not have given any perceptible increase of the velocity. That table makes one-tenth of the shot's weight give 1004 feet, 974·5 feet, or 1013 feet from guns; we say 900 feet from mortars.

14. We shall now leave Dr. Gregory, and turn to Dr. Cape, who in his "Course of Mathematics" gives the following example on the law of gravity, vol. 2, page 216:—

"An arrow shot perpendicularly upwards from a bow, returned again in 10 seconds; required the velocity of projection, and the height to what it rose?

"Ans.—Velocity 161; height 402·5 feet."

15. *Negatur.* If the fall by gravity were, as held by Dr. Cape, in any time, t, equal to the square of the time multiplied by 16·1, then the height and velocity would be exactly double that given by Dr. Cape. The rising and falling of the ball would be, in that case, as is shown in the following table:—

Flight, 10 Seconds.

Seconds of Time.	Ascent.		Descent by Gravity.	Height at each period of Time.
	Gradual.	Cumulative.		
1	305·9	305·9	16·1	289·8
2	273·7	579·6	64·4	515·2
3	241·5	821·1	144·9	676·2
4	209·3	1030·4	257·6	772·8
5	177·1	1207·5	402·5	805·0
6	144·9	1352·4	579·6	772·8
7	112·7	1465·1	788·9	676·2
8	80·5	1545·6	1030·4	515·2
9	48·3	1593·9	1304·1	289·8
10	16·1	1610·0	1610·0	0·0

16. Of this any gentleman may convince himself by supposing the same time of flight, but 45° of elevation; then the range would be $t^2 \times 16{\cdot}1 = 10^2 \times 16{\cdot}1 = 1610$ feet; the velocity $20\sqrt{2} \times 16{\cdot}1$ or $20 \times 16{\cdot}1\sqrt{2} = 322\sqrt{2}$; showing that the vertical velocity was $20 \times 16{\cdot}1 = 322$ feet not 161—.

17. But, to draw the true trajectory, the above law of gravity must be altered as follows:—

B G	A G	A B
16·2	282·6	282·6 $\sqrt{\frac{2}{2}}$
64·4	538	538 $\sqrt{\frac{2}{2}}$
144	765·6	765·6 $\sqrt{\frac{2}{2}}$
254·4	964·8	964·8 $\sqrt{\frac{2}{2}}$
395	1135	1135 $\sqrt{\frac{2}{2}}$
565·2	1275·6	1275·6 $\sqrt{\frac{2}{2}}$
764·4	1386	1386 $\sqrt{\frac{2}{2}}$
992	1465·6	1465·6 $\sqrt{\frac{2}{2}}$
1247·4	1513·8	1513·8 $\sqrt{\frac{2}{2}}$
1530	1530	1530 $\sqrt{\frac{2}{2}}$

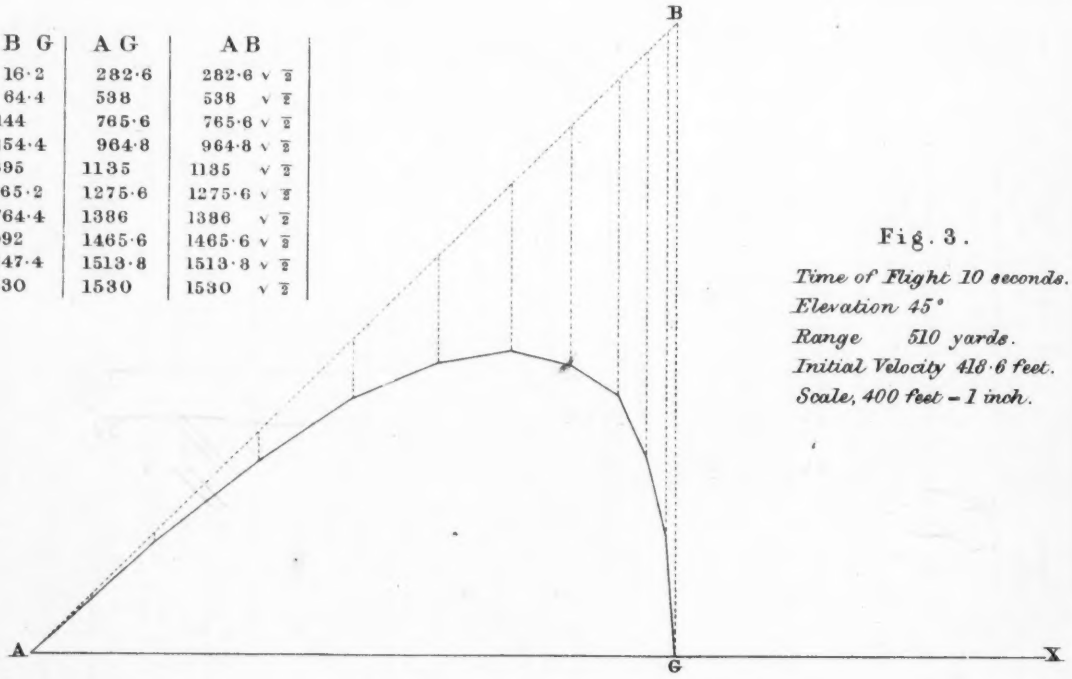


Fig. 3.

Time of Flight 10 seconds.
Elevation 45°
Range 510 yards.
Initial Velocity 418·6 feet.
Scale, 400 feet = 1 inch.

J.R.Jobbins.

Seconds of Time.	Ascent.		Descent by Gravity.	Height at each Second of Time.
	Gradual.	Cumulative.		
1	282·6	282·6	16·2	266·4
2	255·4	538·0	64·4	473·6
3	227·6	765·6	144·0	621·6
4	199·2	964·8	254·4	710·4
5	170·2	1135·0	395·0	740·0
6	140·6	1275·6	565·2	710·4
7	110·4	1386·0	764·4	621·6
8	79·6	1465·6	992·0	473·6
9	48·2	1513·8	1247·4	266·4
10	16·2	1530·0	1530·0	0·0

18. In Figure 3 we show the true trajectory for 10 seconds time of flight, on a scale of 400 feet to an inch, the elevation being 45°. It is very simple, and obviously true. It is thus constructed: Draw a right-angled triangle, A B G, in which the angles are 45°, 45°, and 90°. Then A G must represent the range, and B G the fall by gravity for 10 seconds. On B G mark off the fall for 9 seconds, 1247·4 feet, and draw a horizontal line. Its intersection with A G will mark the portion of A G through which, if not acted upon by gravity, the ball would have passed in the first of the ten seconds of its flight. Let fall a perpendicular, 16·1 feet in length, and its lower extremity will mark the place of the ball at the expiry of the first of the 10 seconds. In like manner we mark the fall for 8, 7, 6, 5, 4, 3, 2, and 1 seconds, and draw horizontal lines, which will divide A G in proportion, as shown in our para. 17. The column marked "Cumulative Ascent" shows the distance from A, measured vertically on A G. Therefore the distances are $282{\cdot}6\sqrt{2}$, $538\sqrt{2}$, $765{\cdot}6\sqrt{2}$, $964{\cdot}8\sqrt{2}$, $1135\sqrt{2}$, $1275{\cdot}6\sqrt{2}$, $1386\sqrt{2}$, $1465{\cdot}6\sqrt{2}$, $1513{\cdot}8\sqrt{2}$, and $1530\sqrt{2}$—which is the whole length of A G.

19. This ascent would be the same at any other elevation as at 45°. If gravity were not acting upon the ball it would, at any elevation, go $1513{\cdot}8\sqrt{2}$ feet in 9 seconds. Now suppose that gravity does act, we see that the fall by gravity is 1247·4 feet for 9 seconds. Then we find the range thus: $A\,B^2 - B\,G^2 = A\,G^2$. But the portion of A B for 9 seconds is $\frac{9}{10}1513{\cdot}8\sqrt{2}$, and B G is 1247·4; therefore A G = 1739·87 feet, the range for this time of flight, which is 70 yards further than the range at 45°. The elevation to give this is easily found, as $1513{\cdot}8\sqrt{2} : 90° :: 1247{\cdot}4 : 28°\ 16'\ 10''$, the required elevation.

20. The initial velocity for 10 seconds of flight at 45° is $296\sqrt{2}$, or 418·6 feet per second; its range 510 yards. The French Table, p. 422

of the *Aide-Mémoire*, gives for 9 seconds 487 yards; for 10½ seconds, 537 yards; therefore for 10 seconds about 500 yards—ours being 510.

21. Supposing that, instead of firing the ball vertically upwards with initial velocity V, we were to give a small additional charge of powder, and elevation 85°, the additional charge of powder being exactly that which would preserve the same time of flight. Then, the time of flight being the same, the fall by gravity must of necessity be the same also; and the range, being measured, will enable us to calculate the exact height to which the ball would have ascended, if it had not been acted upon by gravity.

22. In Figure 4, let B G represent the fall by gravity in the time of flight, whether for 25·5″, as in Doctor Gregory's case, or for ten seconds, as in Doctor Cape's. Then, if we measure A G, the range at 85°, we can easily calculate the exact length of B G. For as sin. 5° : A G : : sin. 85° : B G. Supposing that we fired with a certain charge, and found that at 85° the range A G was 1106·24 feet, then we should know that B G = 8940·9375 feet.

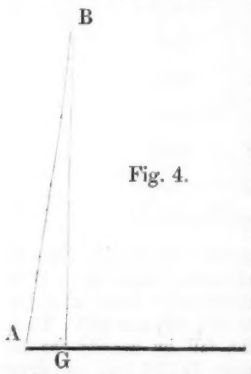


Fig. 4.

23. There is no reason why we should not fire the larger 10-inch howitzer of 6¼ tons weight with such a charge as would, at 85° elevation, give a range of 1106·24 feet, or 368·75 yards. Any range at this elevation would do as well; but suppose that, by chance, the range were to prove exactly 1106·24 feet, and that, firing the solid shot of 140lbs. weight, we made the charge of powder exactly such, that we could be certain of getting the same range, then if we were to lay the target of the electro-chronoscope level on the ground, covering the spot on which by experiment we knew the ball would fall, the ball would cut the electric wire, and we should know that the time of flight had been 25·49997 seconds, which we should call 25·5 seconds. We should then calculate the height which would give us the measure of the fall by gravity in 25·5 seconds, which we have hitherto never been able to determine.

24. Or if we fired with a very small charge at 85°, and finding the range to be 133·8676 feet, then placing the target of the electro-chronoscope on the spot struck, and firing again, suppose the wire to be cut in 9·99997 seconds, which we should call 10 seconds, then we should calculate B G by saying, as the sin. 5° : 133·8676 : : sin. 85 : 1529·9997, which we should call 1530, and determine thence that the fall by gravity for 10 seconds is 1530 feet, or $10^2 \times 15{\cdot}3$ feet.

25. A few experiments of this nature with the electro-chronoscope would settle all the undetermined questions in gunnery, and render our science as certain as any of the others which have been brought to such perfection by mathematical calculations.

26. The electro-chronoscope will for a thirtieth or fortieth part of the price of the ballistic pendulum give us far more accurate results; the expense, after the purchase of the instrument itself, is only the powder burnt, and we may now hope to know the real path of our projectiles.

27. No method appears to present itself of calculating exactly the range from the elevation, except at 45°, but we can calculate the range for given time, and then find the angle of elevation which would give it. For example, suppose the time 20·1 seconds. Then B G, the fall by gravity, is $20{\cdot}1^2 \times 14{\cdot}29$ feet = 5773·3029 feet. And A B we find thus:—From 25·5 deduct 20·1; the difference is 5·4.

From 8940·9375, the fall for 25·5 seconds.
Take 459·5616, the fall for 5·4.
It leaves us 8481·3759, the ascent for 20·1 seconds.
Then 8481·3759 $\surd 2$ is the ascent at any angle in the time 20·1 seconds.

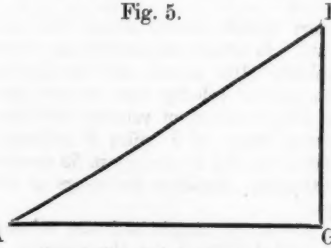
We now say, as 8481·3759 $\surd 2$: 90° :: 5773·3029 : the angle of elevation, which is 28° 46′ 20″. Hence we find the range 10513·6 feet; or 3504·5 yards. In this manner we have calculated the table B, from which it will appear that with this velocity, 900 feet per second, the angle of elevation for greatest range is 28° 32′ 40″ which throws two feet further than 28° 46′ 20″. We showed, in a letter of the 23rd July last, addressed to the gentlemen of the Institution of Civil Engineers, that with velocity 1000 the greatest range was obtained at 28° 53′ 45″, which indicates that the elevation for greatest range will always be about 28° 30′ to 29°—.

28. Our limits do not permit of drawing the trajectory for 25·5 seconds time of flight, but a sketch of that for 10 seconds is herewith given.* It shows the height attained in a flight of 10 seconds at 45° to be 740 feet, as calculated in our paragraph 17, and this after travelling over a horizontal distance of 1135 feet; so that neither is the vertical height quite equal to half what it would have been if not acted upon by gravity, viz. 765 feet, nor is the horizontal distance of culmination quite equal to three-quarters of the range 1147·5 feet.

29. We will give one more example of the working of this problem. On the 24th of November, 1854, at Shoeburyness, the 10-inch howitzer of 125 cwt. is recorded to have thrown its shot of 140lbs. to a distance of 4800 or 4900, say 4850 yards, at 30° elevation, the charge being 16lbs. of powder. The initial velocity is not given; we will find it from the above data.

In the triangle A B G we have the three angles 30°, 60°, and 90°, and we have A G, the range of 4850 yards or 14,550 feet; we, therefore, easily find

Fig. 5.



B G = 8400·4 feet and
A B = 16800·8 feet.

Here B G represents the fall by gravity, and we deduce the time of flight from the measure of the fall by gravity. In 24·64 seconds the fall by gravity is $24{\cdot}64^2 \times 13.836 = 8400{\cdot}2451456$ feet, therefore, 24·64 seconds must have been the time of flight.

The report shows incidentally that there was no accurate instrument

* Vide Fig. 3, at paragraph 17.

employed to measure the true time of flight; mere ocular observation is not to be depended upon; we shall assume that 24·64 seconds is the time of falling 8400·4 feet, and, therefore, of the range now in question.

30. The next question is to find what velocity would carry a ball from A to B, 16800·8 feet, in 24·64 seconds of time, gravity not acting.

We find that 16800·8 divided by the square root of 2 gives us $\frac{16800{\cdot}8}{\sqrt{2}} = 11880$, therefore the velocity required to throw a ball vertically upwards 11880 feet in 24·64 seconds of time, if not opposed by gravity, is one of the two equal components of the initial velocity sought.

Now, a ball falling from a height of
12454·7840768 feet will reach the ground in 30·68 seconds
572·6151936 being passed through in 6·04 seconds, so that
11882·1688832 feet were passed through in 24·64 seconds. This is only 2 feet more than we wished. But a ball falling by gravity from a height of feet
12447·6068937 will reach the ground in 30·67 seconds,
570·7570473 being passed through in 6·03 seconds, so that
11876·8498464 feet were passed through in 24·64 seconds, which is 3 feet less than we wished. Therefore 30·676 is the time in which a ball would, by falling, gain such velocity that in the last 24·64 seconds it should fall through 11880 feet, and the velocity it would thereby have acquired is easily found. From
12454·784, the fall for 30·68 seconds, deduct
12447·607, the fall for 30·67, and the difference, being
7·177 is the fall in one-hundredth of a second; then
717·7 is the velocity acquired by falling 30·676 seconds.

31. Then the resultant or equivalent of two equal velocities, one vertical, the other horizontal, each being 717·7 feet per second, will be $717{\cdot}7\sqrt{2}$, or 1015 feet, the true initial velocity which would give a range of 4850 yards at 30° elevation. And we have seen that the vertical or horizontal space passed over, if not acted on by gravity, would be for 45° elevation 12451·2 feet, or 4150·4 yards.

32. This agrees tolerably well with our former calculation, that velocity 1000 would range 3973 yards; it adds 177 yards of range for additional 15 feet of velocity.

33. It is to be regretted that artillery writers should always use such very great velocities in their arguments. It renders impossible any experimental test. Nothing above a velocity 1100 should ever be taken as matter for argument; that would be greater velocity than we ever have attained in practice. What is the use of talking of velocity 1250 feet, when it would at 45° elevation give a range of 5 miles 6 furlongs? Its time of flight would be 53 seconds; the fall by gravity in 53 seconds is $53^2 \times 11 = 30{,}899$ feet, or 10,300 yards; therefore the range at 45° is 10,300 yards, or 5 miles 6 furlongs.

34. We are now in a condition to give a very simple and easy solution of the question which so many have called difficult, viz. the measure of the retardation of the ball by the resistance of the atmosphere. The initial velocity of the ball which, when fired vertically upwards, returned to the ground in 25·5 seconds, we have shown to be 636·13849 feet per second. If wholly unopposed, this ball would have gone from A to Z,

Fig. 1, a distance equal to T V, *vide* paragragh 4. Hence T = 25·5, and V = 636·13849; therefore T V = 16221·531496 = A Z.

If we deduct 8940·9375 the length of A Y, we find the difference 7280·593995 feet, the length of Y Z, and the measure of the retardation by the resistance of the atmosphere, a ball travelling with velocity 636·13849 feet per second.

35. We have, in paragraph 13, expressed a doubt whether gunpowder can give to iron ball a velocity of 2000 $\surd 2$; we are by no means sure that it could give 2000 feet velocity; we are very sure that cast-iron guns are not to be trusted with any velocity approaching that. The 32-pounder gun of 9 feet 7 inches, 63 cwt. which burst at Deal in 1837, was only charged with $\frac{375}{1000}$ of its shot's weight; it was giving velocity less than 1000 feet per second when it yielded.

36. It is much to be regretted that all our artillery writers employ such enormous, such imaginary, velocities, when they adduce examples to illustrate their arguments. Captain Boxer, of the Royal Artillery, supposes an initial velocity of 1774 feet per second, when he means to prove that at 35° the range will be greater than at 45°, and the consequence is, neither he, nor any one else, can tell what either elevation would give as range for such velocity. It is much to be desired, that all should agree on some one velocity, say 1000 feet per second, and let all calculations have reference to that.

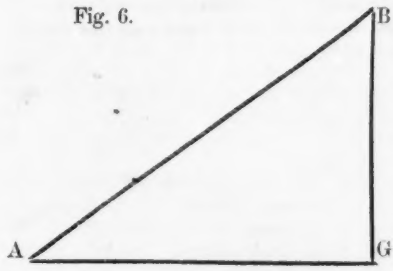
37. Captain Boxer quotes Hutton for various approximations to the elevation for giving maximum range, as given by Newton, Robins, Euler, and Robinson; and he shows Hutton's calculation for a 24-pounder, with velocity 1640 feet, which, Hutton says, would at 34° 15′, throw 8336 feet, and this he fixes as the greatest range which that velocity could give to a 24-pounder ball. It is true Captain Boxer does say that this range is "considerably less than that found by experiment," but he does not point out the fatal error which vitiates the whole of this calculation.

38. Hutton reasoned in the wrong direction, he could not possibly arrive at the truth. He fixes a theory of terminal velocity, and deduces ranges which every day's practice proves to be erroneous. Let us put the question as it should be put, reason from the supposed facts, and see the result. The given facts are the range 8336 feet, and the elevation 34° 15′. Required the initial velocity. Hutton ascribes this range and elevation to velocity 1640 feet per second. We shall prove that initial velocity 829·13 feet per second is the true measure. In the triangle A G B, let A G be the given range 8336 feet, the angle G A B 34° 15′, the angle G B A 55° 45′, the angle B G A 90°, then the side

B G = 5675·78,

and A B = 10084·8 feet.

Fig. 6.



In this triangle A G is the range, B G the fall by gravity, A B the ascent, if not deflected by gravity. Then, as the fall by gravity is

5675·78 feet, we may be sure the time of flight is 19·92 seconds, because $19{\cdot}92^2 \times 14{\cdot}308 = 5677{\cdot}5$ feet, only 1·72 feet over, and near enough for our purpose.

39. It only remains to show the initial velocity which would carry a ball from A to B in 19·92 seconds, if not opposed by gravity. As it is seen to do this at 34° 15′, clearly it would do so at 45° or any other elevation, the resistance of the atmosphere being the same whatever angle we fire at; the velocity being the same, the distance traversed will be the same if gravity does not act. At any elevation the velocity may, with advantage, be considered as the resultant or equivalent of two velocities, one of them vertical, represented by the sine of the angle of elevation; the other horizontal, represented by the cosine of that angle. To calculate radius, let us suppose sine and cosine equal, that is to say, let us suppose elevation 45°, then the vertical velocity and horizontal velocity each will be represented by v, and their resultant or equivalent, $v\sqrt{2} = V$, the said V being the real initial velocity of the ball. Dividing A B by the square root of 2, we get the distance $\frac{10084{\cdot}8}{0{\cdot}1414213562} = 7131{\cdot}04$ feet, and we see that this is the vertical height to which, if not opposed by gravity, the vertical velocity v would carry the ball in 19·92 seconds.

40. To ascertain what v is, we must see what height a ball must fall from, to acquire by falling such velocity as to pass through 7131·04 feet in the last 19·92 seconds of its fall, and this, though tedious, is not difficult. We find after some few trials that if a ball be suffered to fall by gravity from a height of 7258·8140625 feet it will reach the ground at the end of 22·75 seconds of time, and in the earlier 2·83 seconds of this it will have passed through ($2{\cdot}83^2 \times 16{\cdot}017$ feet) = 128·27855112 feet, so that in the remaining 19·92 seconds it would fall through 7130·5355112 feet, only 6 inches short of 7131·04, the desired length, or $\frac{AB}{\sqrt{2}}$. The velocity v, which a ball acquires by falling 22·75 seconds, is thus found:

$22{\cdot}75^2 \times 14{\cdot}025 = 7258{\cdot}8140625$
$22{\cdot}74^2 \times 14{\cdot}026 = 7252{\cdot}9511976$

a difference of $5{\cdot}8628649$ feet in 0·01 second, showing a velocity, v, of 586·28649 feet per second.

41. Then as ($V = v\sqrt{2}$) the initial velocity, resultant or equivalent of two velocities of 586·28649 each, is equal to $586{\cdot}28649\sqrt{2}$, it is 829·1343, as we said in para. 38 we should prove it to be.

42. We subjoin a table, C, by which any artillerist may amuse himself by finding the angle of elevation for any time of flight with this velocity, and we shall give three examples of

TABLE A.

Time of Flight 25·5 Seconds. Initial Velocity 636·1385 feet per Second.

Seconds of Time.	Vertical Ascent (in feet).		Fall by Gravity (in feet).	Actual Height attained in the whole Time.	Space passed through in each Half-Second.
	Gradual.	Cumulative.			
0·5	315·9375	315·9375	4·0625	311·875	311·875
1	311·5375	627·475	16·2	611·275	299·4
1·5	307·0625	934·5375	36·3375	898·2	286·925
2	302·5125	1237·05	64·4	1172·65	274·45
2·5	297·8875	1534·9375	100·3125	1434·625	261·975
3	293·1875	1828·125	144·	1684·125	249·5
3·5	288·4125	2116·5375	195·3875	1921·15	237·025
4	283·5625	2400·1	254·4	2145·7	224·55
4·5	278·6375	2678·7375	320·9625	2357·775	212·075
5	273·6375	2952·375	395·	2557·375	199·6
5·5	268·5625	3220·9375	476·4375	2744·5	187·125
6	263·4125	3484·35	565·2	2919·15	174·65
6·5	258·1875	3742·5375	661·2125	3081·325	162·175
7	252·8875	3995·425	764·4	3231·025	149·7
7·5	247·5125	4242·9375	874·6875	3368·25	137·225
8	242·0625	4485·	992·	3493·	124·75
8·5	236·5375	4721·5375	1116·2625	3605·275	112·275
9	230·9375	4952·475	1247·4	3705·075	99·8
9·5	225·2625	5177·7375	1385·3375	3792·4	87·325
10	219·5125	5397·25	1530·	3867·25	74·85
10·5	213·6875	5610·9375	1681·3125	3929·625	62·375
11	217·7875	5818·725	1839·2	3979·525	49·9
11·5	201·8125	6020·5375	2003·5875	4016·95	37·425
12	195·7625	6216·3	2174·4	4041·9	24·95
12·5	189·6375	6405·9375	2351·5625	4054·375	12·475
12·75	92·4984375	6498·4359375	2442·5015625	4055·934375	1·559375
13	90·9390625	6589·375	2535·	4054·375	1·559375
13·5	177·1625	6766·5375	2724·6375	4041·9	12·475
14	170·8125	6937·35	2920·4	4016·95	24·95
14·5	164·3875	7101·7375	3122·2125	3979·525	37·425
15	157·8875	7259·625	3330·	3929·625	49·9
15·5	151·3125	7410·9375	3543·6875	3867·25	62·375
16	144·6625	7555·6	3763·2	3792·4	74·85
16·5	137·9375	7693·5375	3988·4625	3705·075	87·325
17	131·1375	7824·675	4219·4	3605·275	99·8
17·5	124·2625	7948·9375	4455·9375	3493·	112·275
18	117·3125	8066·25	4698·	3368·25	124·75
18·5	110·2875	8176·5375	4945·5125	3231·025	137·225
19	103·1875	8279·725	5198·4	3081·325	149·7
19·5	96·0125	8375·7375	5456·5875	2919·15	162·175
20	88·7625	8464·5	5720·	2744·5	174·65
20·5	81·4375	8545·9375	5988·5625	2557·375	187·125
21	74·0375	8619·975	6262·2	2357·775	199·6
21·5	66·5625	8686·5375	6540·8375	2145·7	212·075
22	59·0125	8745·55	6824·4	1921·15	224·55
22·5	51·3875	8796·9375	7112·8125	1684·125	237·025
23	43·6875	8840·625	7406·	1434·625	249·5
23·5	35·9125	8876·5375	7703·8875	1172·65	261·975
24	28·0625	8904·6	8006·4	898·2	274·45
24·5	20·1375	8924·7375	8313·4625	611·275	286·925
25	12·1375	8936·875	8625·	311·875	299·4
25·5	4·0625	8940·9375	8940·9375	0·0	311·875

TABLE B.

Initial Velocity $636{\cdot}1385\sqrt{2} = 899{\cdot}6357$.

Time of Flight.	Elevation.	Range.		Logm. Sine of Elevation.
		Feet.	Yards.	
1	1° 2·48	887·3	296	8·2614035
2	2 6·20	1749	583	5659836
3	3 11·30	2581	860	7458417
4	4 18	3384·5	1128	8747728
5	5 25·50	4156	1385	9759105
6	6 35	4895	1632	9·0595654
7	7 46·30	5598·5	1866	1312426
8	9	6264·7	2088	1942343
9	10 15·30	6889	2296	2506685
10	11 34	7478	2493	3021649
11	12 55	8021	2674	3492624
12	14 19·12	8518	2839	3932924
13	15 47	8967	2989	4346188
14	17 24	9366·5	3122	4757400
15	18 55	9711·7	3237	5110150
16	20 37·20	10000·6	3333·5	5467733
17	22 24	10229·6	3410	5812694
18	24 19·30	10391	3463	6148063
19	26 21·30	10492	3497	6473401
20	28 32·40	10515·6	3505·2	6792848
21	30 54	10459·1	3486·7	7107058
22	33 29	10314	3438	7417624
23	36 19·30	10072·9	3357·6	7725857
24	39 28·40	9720	3240	8033079
25	43 2	9238·2	3079·4	8340584
25·5	45	8941	2980·3	8494850
	50	8127·6	2709·2	
	55	7252·5	2417·5	
	60	6322·2	2107·4	
	65	5343·7	1781·2	
	70	4324·6	1441·5	
	75	3272·6	1091	
	80	2195·6	732	
	85	1102	367	
	90	0	0	

TABLE C.

Time of Flight 22·75 Seconds. Initial Velocity 586·2865 feet per Second.

	Vertical Ascent (feet).		Fall by Gravity (feet).
	Gradual.	Cumulative.	
0·5	290·809375	290·809375	4·0625
1	285·996875	576·80625	16·2
1·5	281·109375	857·915625	36·3375
2	276·146875	1134·0625	64·4
2·5	271·109375	1405·171875	100·3125
3	265·996875	1671·16875	144
3·5	260·809375	1931·978125	195·3875
4	255·546875	2187·525	254·4
4·5	250·209375	2437·734375	320·9625
5	244·796875	2682·53125	395
5·5	239·309375	2921·840625	476·4375
6	233·746875	3155·5875	565·2
6·5	228·109375	3383·696875	661·2125
7	222·396875	3606·09375	764·4
7·5	216·609375	3822·703125	874·6875
8	210·746875	4033·45	992
8·5	204·809375	4238·259375	1116·2625
9	198·796875	4437·05625	1247·4
9·5	192·709375	4629·765625	1385·3375
10	186·546875	4816·3125	1530
10·5	180·309375	4996·621875	1681·3125
11	173·996875	5170·61875	1839·2
11·5	167·609375	5338·228125	2003·5875
12	161·146875	5499·375	2174·4
12·5	154·609375	5653·984375	2351·5625
13	147·996875	5801·98125	2535
13·5	141·309375	5943·290625	2724·6375
14	134·546875	6077·8375	2920·4
14·5	127·709375	6205·546875	3122·2125
15	120·796875	6326·34375	3330
15·5	113·809375	6440·153125	3543·6875
16	106·746875	6546·9	3763·2
16·5	99·609375	6646·509375	3988·4625
17	92·396875	6738·90625	4219·4
17·5	85·109375	6824·015625	4455·9375
18	77·746875	6901·7625	4698
18·5	70·309375	6972·071875	4945·5125
19	62·796875	7034·86875	5198·4
19·5	55·209375	7090·078125	5456·5875
20	47·546875	7137·625	5720
20·5	39·809375	7177·434375	5988·5625
21	31·996875	7209·43125	6262·2
21·5	24·109375	7233·540625	6540·8375
22	16·146875	7249·6875	6824·4
22·5	8·109375	7259·796875	7112·8125
22·75	1·0171875	7258·8140625	7258·8140625

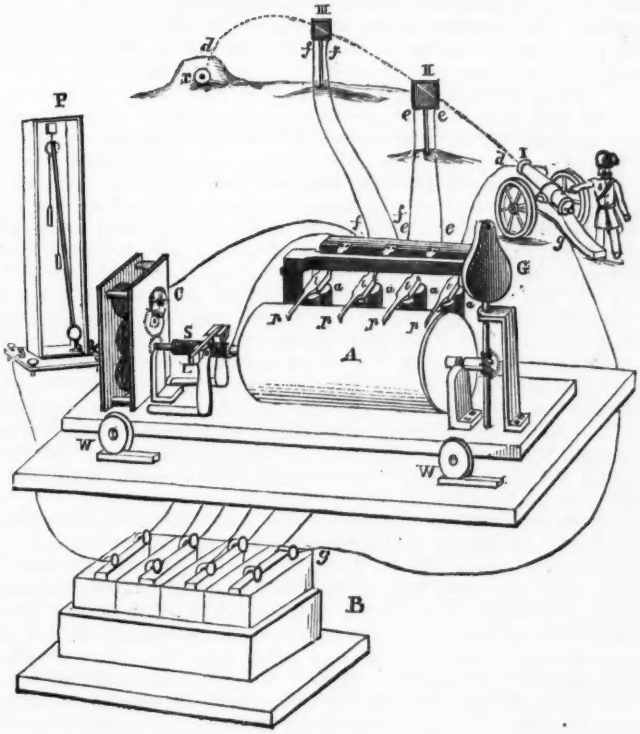
AN ELECTRO-CHRONOSCOPE,

Invented by Major-General ANSTRUTHER, C.B.

DESCRIBED BY C. BECKER.

THE object of the electro-chronoscope is to measure exactly the time of flight of a projectile between two given points. Various modes of taking the time of flight have been in use for years. The simplest is a sort of clock, which is divided into 600 parts, and which is traversed by a hand once a minute, and which may be set going and stopped by touching a lever, and from which a second hand may be detached in its course. It indicates to tenths of seconds; but, as the accuracy of this instrument depends upon the manipulation of the observer, it is subject to considerable error. The self-registering principle is therefore the only one which will give reliable results. A beautiful self-registering chronoscope, by Navez of Brussels, is used at present at Woolwich, the results of which are said to be surprising; the only drawback of which is that each observation requires a rather troublesome calculation to reduce it to real time.

General Anstruther had an apparatus designed by Mr. Holmes, which was intrusted to Messrs. Elliott for execution. The principle was in the main the same as represented in the woodcut. A cylinder, covered with paper soaked in a solution of ferrocyanide of potassium, had to revolve driven by a weight. Small iron wheels attached to slight springs had to trace, by decomposition, blue lines on the paper, on the principle of Bain's electric printing telegraph, as long as an electric current passes; but when put into practice it was found that, if we may call it so, a sort of ink was formed which continued to mark after the current was broken, and consequently the object aimed at, extreme accuracy, was lost. In conjunction with Mr. Bashley Britten, C.E., Messrs. Elliott altered the plan. Instead of making use of chemical decomposition by an electric current, they substituted metallic paper for the cylinder A, and a clockwork C for the weight. At *a a a a* of sketch are 4 electro-magnets made of the same material, in exactly the same manner—a matter of some importance, as we shall presently see. The keepers are attached to springs which carry metallic points *p p p p*. When the electric current makes the iron magnetic, the keeper is attracted, and the metallic point presses gently on the paper; one of the electro-magnets is in connection with an accurately timed seconds pendulum, which at every beat makes connection for a fraction of a second, or, in other words, makes the magnet attract the keeper every second, and dots on the paper cylinder. Thus we have a second registered independently of the velocity with which the cylinder rotates. If the rotation is quicker, the two dots will be further apart; and *vice versâ*. The three other electro-magnets are in electric connection with three targets, one of which is distant about one foot from the muzzle of the gun, the second and third at 100 or 200 yards, or at any other required distance. The first target consists of a simple copper



wire, which is broken by the ball leaving the gun. The targets Nos. 2 and 3 consist of frames of common deal wood 6 feet square, across which a copper wire passes backwards and forwards close enough to allow no ball to pass through without breaking it. These frames can be raised to such height as the angle of elevation at which the gun is fired renders necessary. The cylinder A has a screw S cut on its axis, which serves as a means of propelling it while the metallic points draw, so that the lines do not fall upon each other, but run spirally round the cylinder with the pitch of the screw. For that purpose the cylinder with clockwork is fixed to a carriage which runs on the wheels while the lever L and the metallic points at *p p p p* remain stationary. At the further end is a governor to ensure equal velocity of rotation.

The apparatus is used in the following manner. A galvanic battery is connected with each of the four electro-magnets; one takes into its circuit the pendulum, the second the target at the muzzle of the gun, the third the target at 100 yards distance, the fourth the target at 200 yards; the pen-

dulum is then set going, and dots on the cylinder, which is, however, not yet in motion. The clockwork is now set going, and the three points draw lines. After one or two revolutions the command to fire is given, when the ball, in leaving the gun, breaks the wire of No. 1 target, and point No. 1 ceases to draw. When the second target is struck, point No. 2 ceases to draw; and when the third target is struck, point No. 3 ceases to draw. The clockwork is now stopped. To ascertain the time represented by these lines, the paper is taken off; where point one has ceased to draw is the starting point or zero; the length of the second and third lines will give seconds and fractions of seconds, when compared with the distance of the two dots made by the pendulum, for which purpose a scale may be used, or an ingenious contrivance of Mr. Holmes's, a compass to one leg of which a screw is attached with 100 turns, a nut turns in the second leg and subdivides one turn of the screw into 100 parts. By moving the trammels either way the points of the compass can be made to take in the two dots which represent the second, and each turn of the screw will give the 100th part of the second, be the distance great or small. A second cylinder is provided, which may be prepared with metallic paper beforehand so as to save time. Various objections may be raised to this apparatus, to some of which we will briefly allude. Electricians will point out that after the current is broken residue magnetism in the soft iron will retard the release of the keeper. We have provided against this error, firstly, by making the electro-magnets exactly alike, as mentioned before, so that we have the same retardation in the release of the three different keepers, and this error will thus be neutralized; secondly, by not bringing the keeper into actual contact with the iron, but interposing a thin brass pin. A second objection might be that the different length of the wires might have different, or unequal, effects on the magnets; if this should be the case, resistance coils might be enclosed in the currents to make them all alike. A third source of error, and perhaps the most inconvenient one, is, that when the three points draw, there is more friction than when they are successively released; but as the amount of friction can be ascertained, it can be allowed for. Only by a great number of reliable observations the theory of projection can be elucidated; and General Anstruther would gladly lend the apparatus to any gentleman desirous of its use, expecting only of him to find his own wire, and to make him (General Anstruther) acquainted with the results.*

* The instrument may be inspected at Messrs. Elliott Brothers', 30, Strand.

Evening Meeting.

Thursday, May 30th, 1861.

Captain Sir F. W. E. NICOLSON, Bart., R.N., in the Chair.

ADJOURNED DISCUSSION ON IRON-CASED SHIPS.

The CHAIRMAN. I believe the discussion to be taken to-night is entirely on the hulls of vessels. I have unfortunately myself been absent from the meetings at which Captain Halsted's later papers have been read; but I believe it has been arranged to separate the two subjects of iron plates and hulls in order to avoid confusion in the discussion, and also, I suppose, to induce members who address the meeting to keep their remarks within due limits. I believe that Mr. Grantham has brought a model, the object of which is to show his plan of sheathing iron-ship bottoms with wood and then coppering them.

Mr. GRANTHAM. In addressing the meeting this evening my object is rather to speak generally upon the subject of *hulls*, and if you would permit me I will speak of the model which is before me merely as an incidental question rather than as a prominent one. I will not occupy many minutes with the description of that portion of the subject, if you will allow me a few words upon the subject of hulls generally. I believe it to be even of more importance for discussion before the public than that of plates, and I am very glad of this opportunity of saying a few words upon it.

The subject, as you have wisely decided, divides itself into two questions, the armour-plates and the hulls. Upon the question of armour-plates I have always felt that the Admiralty were themselves the best judges, they alone can conduct the experiments on a scale that will be at all satisfactory in giving results; but upon the subject of hulls, we practical men, who have been for a great portion of our lives engaged in watching the progress of iron ships, in designing and building them, may come in and I think afford material assistance to the Government in considering whether the hull itself is to be of iron, or whether the old system is to be continued. Upon the subject of iron hulls I have myself no doubt whatever. Upwards of 30 years' watching their progress has completely satisfied me, that the hulls of all ships will ultimately in this country be built of iron. We have, indeed, many difficulties to contend with, but I know, and I have seen, that these difficulties one by one have given way to the necessities of the case, or to the acknowledged superiority of the material for building ships. It need not be raised as an objection to a system like this that men only adopt it when they are forced into it. We seldom do in this country adopt great improvements without a necessity arising for them. The early adoption of iron ships was entirely from necessity. Men were beginning to navigate rivers and difficult places, and they soon found

that iron was much better, in point of lightness and also in durability, than wooden ships for such purposes; they therefore adopted them not from choice, but from necessity and from competition. Armour-plates themselves of later times have, I think, been adopted from necessity, not from choice. Our neighbours over the water have adopted them, and therefore we felt ourselves compelled to adopt them also. And in the great race of competition which arises, both commercially and politically, though slow to begin in such matters, we generally are soon in the front ranks, and I doubt not that we shall take the lead in this question also; especially as the material and the means of working the material are near at hand.

I have learned out of doors that serious questions have been raised in this room as to the propriety of Government building the hulls of ships of iron. I believe the question of armour-plates is almost by common consent admitted as one that must have its run; but the *hulls* of ships are still questions in dispute, and I have learned that very strong opinions have been given against the adoption of iron for the hulls of Her Majesty's vessels. Upon this point I wholly differ from the objectors. In the first place, I believe it will be soon felt, and but few years will pass over us before we shall feel it, to have been the most barbarous mistake to clothe ships with 1,000 or 1,500 tons of iron merely for armour, wholly irrespective of any strength which that plating gives to the ship; as it is now, these plates are found to be a great source of straining to the ship, if the ship herself is not exceedingly strong. Now, if we adopt iron hulls, it is quite clear that the combination between the iron hull and the armour-plate becomes quite a different story. We shall no longer require those long bolts, which will soon work loose, but we shall have one solid, compact body, one homogeneous mass. Some of the difficulties which have been started in this room, such as they have been reported to me, are, I think, of that nature which have been so often answered, and, in my mind, so satisfactorily answered, that I really would not occupy the short time of this meeting by even referring to the great mass of them; they have been over and over again refuted—they enter into the very history of iron-ship building; and to touch upon them even, would be to bring up again the history of the principle itself, and, therefore, so far as the answering these objections is concerned, I will not venture to do it; I prefer to offer you a few facts and the opinions of men who formerly notoriously opposed iron ships, and who have only come to the conviction that iron hulls must be adopted, from feeling that the fact of their superiority has been so established that they could not resist the conviction which was forced upon them. Now, there is a class of men who, like those gentlemen connected with the navy, have for a long time felt that they could not adopt iron ships; those gentlemen are the great ship-owners of the kingdom, who have owned the large mass of sailing ships which go to all parts of the world, carrying the most valuable cargoes. These gentlemen have, as a body, including the under-writers, opposed the introduction of iron ships. It was only the necessity of the case in the adoption of steam, that forced iron ships upon us, and we have for some time made up our minds to have nothing but iron ships for steam purposes. But still these men to whom I refer, too strongly held out in many cases, and I think the opinion of three gentlemen such as I

have described will have some weight with this meeting. They are of the class I have named; none of them own steamboats, they are all sailing-ship owners; men of great practice in wooden ships, brought up all their lives in the midst of them, no doubt having strong opinions against iron ships. Now, if you will allow me, you will hear what they say: their letters are not very long, but I think they are so strong that I could not answer the objections that have been raised more easily than by referring to those documents; they have been written within this month. The first is by a very large shipowner of this class, a member of the well-known firm of Charles Moore and Co. of Liverpool. Mr. Carlyle writes:

Liverpool, 26 April, 1861.

Dear Sir,

I have your favour of the 20th inst. and in reply have much pleasure in giving our views about iron ships.

We commenced building them in 1852; have built seven, and have two more on the stocks; their tonnage have been from 1,200 to 1,800 tons each, and we have employed them in the East India trade, mostly to Calcutta.

Since first commencing with iron ships we have been fully convinced of their superiority over wooden ones, but for some years we were partly kept back by the prejudices of shippers and underwriters; these have now happily not only been removed, but have been succeeded by a decided preference for iron ships, and this, combined with our own experience of them, has led us to the determination not to build any more wooden ships, but to confine ourselves exclusively to iron. Their advantages are manifold.

They are more durable, not liable to dry rot or worms, require no coppering and caulking, when any damage is sustained you can get at it and repair it locally, without pulling out long shifts of plank; in fact, a comparatively small outlay will keep them in good order.

They are much stronger, and not so liable to strain, indeed they may take the ground, if not rocky, even when loaded, with impunity, where a wooden ship would almost go to pieces, indeed wooden ships seem only capable of sustaining weight when afloat, and almost depend on the pressure of the water for keeping them together.

I may further remark that we have for eight or nine years been using iron lower masts, they are much lighter and stronger than wood, and not more expensive, if required of large size. We consider them very much more durable than wood. We never intend to put a wooden mast into a large ship again; indeed, we are now making our topmasts of iron, and our lower and topmast yards of homogeneous metal.

I am, dear Sir,
Your most obedient servant,
ROB. CARLYLE.

John Grantham, Esq. C.E. London.

The next letter is written by the largest owner, I believe, of iron ships in the kingdom, Mr. William Edward Bates:—

Liverpool, April 20, 1861.

My dear Sir,

I have your note. I have twelve iron ships, the largest is { 2,350 tons O.M. / 2,160 „ N.M.

I have owned iron ships now for eight years myself, but I have been connected with those that have had them for eighteen years.

You cannot, in my opinion, compare iron with wooden ships at all, the difference is so great. For instance, the ship alone named "The Bates Family" got on the Pluckington Bank with 3,400 tons of cargo on board from Bombay; she came off with the tide, went into dock, and discharged her cargo in most beautiful order; went into graving dock for examination and painting, was surveyed most minutely, and found not to have injured herself in the slightest. Had she been a wooden ship she would have broken her back in two minutes, as the "Gladiator" did on the same bank about ten months before this time; went into John Laird's graving dock at Birkenhead, and cost the owners and underwriters something like 10,000*l.* for repairing her.

2nd. They are not half the expense to keep up; no carpenters, no coppering, no dry rot, no caulking, good iron masts, bowsprit, and lower yards; these last as long as the ship; good iron-wire rigging (standing).

3rd. They deliver their cargoes in much better order than wooden ships.

4th. Were our men-of-war built of iron, iron masts, &c. my opinion is, that our naval expenditure would dwindle down to one-half of what we now pay; there would be no dry rot, worm-holes, or things of this kind.

Yours obediently,

EDWARD BATES.

John Grantham, Esq.

He then speaks of an accident which occurred to one of his iron ships on a coral reef, and which, he says, was superior to any wooden ship, from the way in which she stood, but that is always a matter of conjecture when ships go upon rocks; but the next letter is written by the Chairman of the Shipowners' Association at Liverpool, and his opinion is therefore entitled to great respect. He, however, writes in a different strain, not prejudicially to iron, but not as an owner of iron ships; he is a very large owner of wooden ships, and you will hear what he says,—

My dear Sir,

As I have only one iron ship, my experience of them is very limited, particularly as she is now only on her first voyage.

It won't do to "halloo until I am out of the wood;" but I have seen for some time the advantages of iron ships over wood in durability, carrying capacity at same tonnage, saving in cost of repairs, &c. &c., that I should be very wrong to build another ship of wood. There is only the "fouling" against them, which none of the patents yet get over, for where they do claim to have done so, it was the action of the tides in fresh water rivers that has cleaned their bottoms, to wit, Calcutta; but take Aden, and barnacles four inches long (truly) I have seen come off their bottoms. For Calcutta trade, iron ships answer splendidly; and for that trade half a dozen iron ships are now built and owned here for one woodon one, but the Londoners still seem to stick to wood. My opinion is iron ships will be the salvation of England in the great race of competition, and I only hope Brother Jonathan will stick to his "heavy protective duties," and continue to grant registry only to ships built in the States, when British shipowners will maintain the supremacy of the seas in spite of the ruinous legislation of the past few years.

I am, yours faithfully,

JAMES BEAZLEY.

John Grantham, Esq.

I will not enter into his politics, but the feeling he has with regard to iron ships is evident. I quite feel with him, that in the race of competition, whatever may be the course pursued by different nations, we have the lead. I believe the same argument applies strictly to our neighbours, and that we shall have the superiority in this respect in the great race of competition, and I may say generally, that I approve of iron ships, as being better, stronger, more durable, more easily kept in repair, with much less wear and tear than wooden ships, indeed, they have every advantage over wooden ships. I believe the argument applies as well to ships in the navy as to ships in the merchant service, for I can see no material reason why they should answer in one and not in the other. There is, however, one disadvantage. No one can deny the disadvantage, it is no use blinking the question. We have never, any of us who are advocates of iron ships, thought it desirable to underrate that objection, because we hoped that something or other would arise to remove the difficulty. This difficulty is felt especially with ships going long voyages and into tropical climes. I am told that Captain Halsted raised this as a great objection

to iron hulls in his last paper. I do not know how he applied it, but I was told that he spoke of *fouling* as being one of the objections against a ship like the "Warrior." He will correct me if I am wrong in this statement.

Capt. HALSTED.—I merely stated that it is a great disgrace to us that it still remains.

Mr. GRANTHAM.—It is *the* difficulty—it is the *incubus* that is on the minds of all of us, and we cannot shake it off—that ships going to foreign climes, unless they can go straight from one port to another, and into fresh-water rivers, must become foul. I believe this, that there is no remedy yet invented for keeping ships clean, nothing at all approximating to a remedy, except that of copper. But it has been found that copper close to iron is inadmissible. We have attempted many remedies, especially with regard to copper. We have had oxide of copper, and other things mixed with solutions, applied to iron ships; they are not any better than other materials. The only approximation we have made to keeping the ship clean is that which makes it most like a polished surface, where things could not so easily adhere; still a ship lying in foreign stations will foul. Now, the remedy, so far as I know, is to copper them, and I think I have introduced a system of coppering an iron ship which is admissible. I will first of all describe it, and then give you an illustration of this fact as a matter of experience. I am now supposing that I am dealing with an armour-ship, when the armour is allowed to go some six feet below the water-line; it is only from that point that I start with the suggestion that I am about to make, because ships can always be kept clean without much trouble a few feet under water; I therefore start from that point. The appearances which the method would present would be therefore unobjectionable, if there were any such objection raised, and not only so, but the application I make somewhat corresponds with the thickness of the iron plate. I start by riveting to the outside, iron ribs rolled of the proper form. These are made for the purpose of retaining a system of wooden wedge-work—blocks of wood, say four inches in thickness; they are formed by machinery, and to a mould, therefore they are not at all expensive. The timber used may be pine, and when made the wedges are simply driven in, but with great power, because, being made rather too large, they become very tight. The inner frame of the ship is reduced in proportion to the additions made on the outside, so that the vessel is not increased in weight or in cost. To this inner frame of wood is secured by brass screwbolts a plank sheathing, the whole being well coated as the wood is applied. I have had an iron model made where iron ribs were used, and the whole became so compact and solid that nothing but cutting it out with a chisel could remove it.

Having done this, and the whole being re-coated again, and every pains taken to make it perfectly solid, and free from any communication with the iron, it is then coppered in the usual way.

There is an objection still to be overcome, and that is, there will be points at which the copper will come in contact with the iron—for instance, at the stern-post, which does not admit of being sheathed. That difficulty, however, is easily got over in this way; the whole of the stern-post should

be cast of strong tough bell-metal, apparently an expensive process at first; but you will find if you go into the calculation that it is not much more, if any more, expense than the present system; whereas great advantages will be attained by having castings instead of the cumbrous heavy forgings which are at present applied. That is the only practical difficulty which meets us.

I need not go further into the explanation, because all practical men here will at once see what is designed by this scheme. I may say the whole thing becomes a solid mass; I ask where is any objection of a practical character. But there are two points that require explanation. First, Is there any communication of an injurious effect likely to take place between the copper and the iron? To answer this, I have lately had a report from two ships which were built in the years 1850 and 1851; one of these, a sea-going ship, is now owned by the East India Company; it was built entirely of iron ribs, and she had plates running fore and aft on those ribs, so that her frame became very solid; it was not plated entirely; there were strips of plates run round the ship to hold the frame together — ribbon-plates I suppose I may call them; over this was planking. These vessels were merely planked in the ordinary way with one plank, and they were coppered; two of them had been for a long time in the East Indies. One of them has lately been wrecked and broken up; the other is still in good order. After the one which was wrecked was broken up, it was found that the iron bolts which secured the planks to the frame were wasted at the outer end near the copper; of the ship still sailing the report is, that she requires new bolting after ten years' service in that country. That is the only objection that has yet arisen; the plates and the angle-iron inside are as good as ever. The one owned by the East India Company is employed as a transport, and in various ways. She has been on reefs and all sorts of things, but both ships showed the same results—the iron-work was perfectly good.

These had bolts, which I entirely avoid in my system, and which I think to be utterly inadmissible; yet these ships were in perfectly good order after ten years' work, with the exception of the bolts. I feel that this is a very strong illustration, because I have here, as I think, a far superior plan, avoiding the objectionable points.

Now there is one other remark which I would make about this; it has been raised as an objection that iron ships, when striking on pointed rocks, are easily penetrated. It is what we acknowledge to be a weakness in our ships, that, though much stronger generally on sandbanks, as a whole, than wooden ships, yet it is easier to knock a hole through their bottoms than in those of wooden ones. We find it to be so. It is a thing I have myself acknowledged in all my publications on the subject, and have never concealed.

Now I think if we had 6 inches of plank well secured to the bottom of the ship it would be some protection, and it certainly would be no disadvantage; I therefore claim it as an advantage to have the sheathing outside rather than otherwise. With regard to the cost of this plan, I have made an estimate, both of cost and weight, and submitted it to the Plate Committee, and I believe it has made a favourable impression. The

weight of the wood, such as you see here designed upon a ship of 3,500 or 4,000 tons, is about 180 tons weight. I think it will not be difficult, seeing what protection this gives to the ship, to reduce the weight of the ship, supposing she is constructed on purpose, to the same extent; and, if you make a calculation, you will see that 180 tons of iron would be more costly than 180 tons of wood; under these circumstances, the cost is not greater, the weight is not greater, and I believe it to be an entire remedy for the fouling. I believe also that the ship itself would last longer than without it. I know that careful painting so completely preserves the outside, that it is a question of minor importance; but the fouling is of great importance; I therefore earnestly recommend this plan to notice. I have kept it back for many years. I published it some years ago, but I have kept it in the back-ground, because I felt that the Government were materially interested in the question, and that they must be the first to introduce it into this country. I know it would be good for other vessels, but it is too great a question for any but a Government to take up; and, if they do not take it, there it may rest.

Capt. SULLIVAN, R.N.—I am sorry we have not a larger audience to-night, because there are gentlemen who must have been here on a former occasion to whom I should like to address one or two words upon a most extraordinary mistake, which has not only been mentioned among naval men, but has actually been given publicity to in one of our naval journals. It is, that I am an opponent of iron-plated ships. I think every one who heard me in this Institution, or at the Institution of Naval Architects, will recollect what I said was, that I had been one of the most strenuous and earliest advocates of iron-plated ships; yet that I thought they should not have iron bottoms. With respect to wooden covering to iron bottoms, I will allow that this plan, which Mr. Grantham has explained, may give as strong a bottom as that of an ordinary wooden merchant ship, because she has only a skeleton frame with a planking of four or five inches. But, when we are speaking of men-of-war, we must consider a ship built of eight, or ten, or twelve-inch scantling, filled in solid and caulked, with four or five-inch oak plank outside that, increasing larger and larger at the ship's bottom, till you get to the bilge timbers, which are twelve or thirteen inches in large ships, and six or seven inches in small ships—a solid baulk of timber. That is a totally different thing from the construction of a wooden merchant ship. It is said that, on sand banks, wooden merchant ships sometimes break up in a way that iron ships do not—a point I will not dispute, because I do not know the facts, though my opinion is, that a strongly-built wooden merchant ship would be far safer on a rock than an iron ship—yet we m ust here consider only wooden ships built for naval purposes, and it is with them I wish to compare iron. The observation I made that caused, perhaps, the most surprise was, that I would not even send troops in iron ships, on account of the great proportional increase of risk to those ships over wooden ships from getting on shore on rocks. I will endeavour to confine myself to-night principally to this fact, because, if I show that an iron ship is not a safe ship to send troops in, if she gets on rocks, then surely we must allowthat it will not do to trust such ships on an enemy's coast, so weak in their bottom, that if they get on a rock they are almost sure to be lost. We must compare what a wooden ship will stand, with what the best iron ships we know of have stood. I wish to confine myself entirely to this point of getting on shore on rocks. I will allow that an iron steamer, built to run from England to America, from a safe port to a safe port, may go as safely, in the long run, as a wooden ship, because she will not be tried in this one way of getting on rocks. It is a totally different thing with men-of-war; they have to keep in with an enemy's coast, and are constantly liable to the risk of getting on rocks. But if we take these iron ships, with the experience we have derived from their getting on shore, we shall then see how utterly unfit they are to be trusted in places where they are likely to get on rocks. Let us go back to one of the

earliest cases, a ship that was wrecked in North America. A naval officer has told me, that he was sent to get off one of our large steamers, one of the first lost on the coast of North America, and the state in which he found her fully confirms the objection that I made some time ago at this Institution, that the compartments rarely save a ship, except, perhaps, where a ship runs her bow only on a rock, when a small bow compartment would probably save her; but where she goes on rocks in the ordinary way, you cannot trust at all to compartments saving a ship, because, any one who has had a ship on a rock aground, and has looked at her bottom afterwards, even if the rock is a small one, will find her bottom torn for a much greater length than the length of any of the compartments. Only yesterday a naval officer told me, that he lately had his ship on shore on a rock so small that he could with difficulty keep the lead on it. His ship was beating over it, in a heavy swell, for ten minutes; and when he got her into dock, though she did not leak, he found sixty feet of the main and false keel torn away. Therefore, any small rock may tear out a greater length of a ship, or drive holes in her bottom over a greater length than the ordinary length of compartments. Now, in the ship I alluded to in North America, the rock she ran on had not only split her throughout the whole of her bow compartment, but had split her past that compartment into one of the mid-ship compartments, both of which filled; and she was so fixed on the rock that all attempts to get her off failed. Take the case of another ship, belonging to the North American line. I mentioned the case of the "India" before; her breaking up in an extraordinary way, and drowning her passengers before they could get into the boats.

A ship of that same Company was lost shortly afterwards in a way in which I believe many iron ships are lost. Should a wooden ship strike a sunken rock in passing, the heave of the sea gets her off again, and she rarely meets with such an injury as to have any risk of foundering; at least she is able, as the "Thunderbolt" did at the Cape of Good Hope, to go along the shore, get into the first cove she can find, and save her people. But an iron ship, under similar circumstances, has her bottom so torn that she founders instantly in deep water. Now, the ship that went to North America the month after the inquiry took place into the loss of the first ship of the Company was never heard of again: a few pieces of her were found on the coast of Nova Scotia, off a point where there are outlying sunken rocks at some little distance from the point. Had that ship gone on shore, some remains would have been found; but instead of that a few bodies, and some light goods with which she was laden, were the only things found. I have no doubt that in passing she struck one of these outlying rocks, and that it ripped her bottom so badly, that she foundered before the people could get into the boats. Again, during the last four years, I have had to go into inquiries into the loss of four ships belonging to the Peninsular and Oriental Company in the Red Sea. In a fifth case, the ship ran her bow on a coral reef, and, though she filled her fore-compartment, her bow only sticking on the reef, she got off with her bow-compartment full. In four cases the ships were totally wrecked from striking on rocks. I am confident that in three out of the four cases not one of the oldest men-of-war in the service would have been lost even though flat-bottom paddle-wheel steamers. The three cases that I am alluding to are the "Ava," on the coast of Ceylon; the "Alma," on a reef in the Red Sea; and one, whose name I do not recollect, at Point de Galle. In two cases the ship ran ashore in smooth water. Now, every naval officer knows if he runs his ship ashore in smooth water or in a moderate sea, so long as there is a rise and fall of tide, or after she is lightened, he can get her off; he never dreams of her bottom being seriously injured, and she must beat very heavily before he has any fear of the kind. In the case of the "Alma," she just grazed the rock first. I have no doubt that graze, which was somewhere near amidships, ripped out all her bottom plates. The next moment she struck very sharply forward, and ran over another rock. I was assured by a passenger who was wrecked in her, there was no sea to hurt her at all—she did not lift at all—it was a clean run on to a rock; yet so suddenly did she fill, that, when he went below to his cabin to try and save his Crimean medals and other things, he had only time to drag his rug off his bed and put it on him, as the cabin was filling rapidly. There is no naval man who will not bear me out in saying that the worst old rattle-trap in our service would have stood any thumping like that; and that if she did not get off again there would be no hurry in taking the passengers off. In the case of the "Alma," she ran on a reef, her quarter fell under water, and she so filled and bilged, that all attempts to get her off failed. Now, in all these cases, where do we hear of compartments saving the vessel? We do not hear of any such cases, because

the bottom of the ship is injured. In that case, in Galle Roads, the vessel was weighing her anchor. She had hove up one anchor, and she only tailed with the after-extreme of the ship over a reef; she struck heavily, till they hauled her a-head, but the compartments did not save her; they had barely time to beach her as she sank under them. The after-compartments ought to have saved that vessel if compartments are of any use; it was in harbour, she only tailed her stern on the rock, and yet she was wrecked in a few minutes: we should not dream of any wooden ship suffering in that way. Here are three ships that were lost instantly. I wish to confine myself as much as possible to giving facts, which are worth fifty opinions. Of course we have the opinions of iron shipbuilders, who will swear there is nothing like iron; and we have the opinions of wooden shipbuilders, on the other hand, who will swear there is nothing like wood. I think those who are not interested one way or the other, only looking to get the best ships for the service, are more likely to form sound opinions than either iron or wooden shipbuilders. I candidly confess I would far rather, if I believed they were the best ships, see every ship of iron to-morrow, because I know we should then have such a superiority of material over the whole world, that we should have no difficulty in maintaining our superiority; but if, with all that desire, we believe we should be wasting the public money, and risking the loss of men and ships in a way that is not justifiable, then, surely, we must go to facts, and see what the results have been, and judge whether it is right to go on laying out money on iron ships.

Now, I take the case of the iron troop-ships. I have taken the trouble to find out what iron ships we have purchased into the service as troop-ships, and what the result of their loss has been—I think every one will allow that that is a fair way to take it—and compare them with wooden ships running an equal number of years. I say these troop-ships, running from port to port, not running through very intricate navigation, have had much less risk of getting on shore than an equal number of wooden ships, on different stations in the world, would have. During the Russian war we know that all the smaller wooden ships in the Baltic were in the midst of dangerous rocks and intricate navigation for a period of two years. Every ship of the in-shore squadrons in that time went through greater dangers than any iron troop-ship would go through. I have not taken these from any official list, but from the published Navy List, and I may have made some mistakes. But the only troop-ships I can find are these, "Birkenhead," "Megæra," "Vulcan," "Simoom," "Himalaya," "Urgent," "Perseverance," "Transit," "Adventure," and "Assistance." In taking the number of years they have run I have given them credit for every thing, from the first time that they were commissioned till they were lost, or up to the present time, with respect to those that are running now. I find 159 years is the total number of years run by ten ships, giving an average of nearly sixteen years each. Now, what has been the result? The "Birkenhead" was lost when no wooden ship would have been lost. The "Transit" was lost when the slightest wooden merchant ship or man of war could not have been lost. The "Assistance" was lost under exactly similar circumstances. The "Perseverance" was lost in an ordinary trade sea, on the coast of Mayo; but, in her case, I will give iron the benefit of the doubt, whether a wooden ship might not have been equally lost—not that I have the slightest feeling myself that she would, when I tell you that this ship came up head to the sea, an ordinary trade sea, before she struck; therefore, the sea was right ahead when she was on the rock. A back turn of the engine, with the ordinary heave of the sea, ought to have taken her off again. But she broke up so quickly that I was told by a gentleman, who heard it from the carpenter of the ship, at Portsmouth, that her fore part broke off and tumbled round alongside; and it was with the greatest difficulty they got the people into the boats, and saved them, before the ship fell to pieces. Now, no one will suppose that a wooden man of war would have broken up in that way. But, allowing that she would have been lost under such circumstances, we have three cases of loss which there can be no doubt were owing to their being iron ships; and in not one of these four cases do we find that the compartments saved them. If the compartments are so valuable why did they not save these ships, particularly when they got on shore in land-locked seas, with smooth water. I suppose no naval officer has ever heard of a wooden ship being lost in a land-locked sea with smooth water. I have known many wooden ships running on shore in that way that did their work for months and years afterwards, without repair. Now, I take the case of the "Assistance," because the "Transit" is a very similar case. I should like you to hear these facts, because in both cases they were troop-ships, employed at a most important time. One was going with a regiment to China, which would have been diverted to India for the

Mutiny, when the loss of the ship was a serious loss. The other was about to embark troops for the Peiho at Hong Kong, on Admiral Hope's expedition the other day. I happen to know an officer that returned, the master of the "Assistance." I wrote and asked him for particulars of the loss of the ship. I may say, as the public press seems to think that naval men are generally in favour of iron ships, that, with very few exceptions, naval men that I have spoken to, since these discussions began, agree with me. A very large majority of them say they are really glad I am working the thing, and that it is perfect nonsense to suppose an iron ship will stand what a wooden man of war will.

This letter is from the master of the "Assistance," a very old naval officer:

"I rejoice to find you are fighting such a good battle with regard to the system of employing iron vessels as troop ships and men-of-war. The 'Assistance' was sufficient to convince me that for all purposes wood must always have an enormous advantage over iron. When the accident happened she was making thirty-eight revolutions, which would give a speed of about seven knots. The water was perfectly smooth, so she remained perfectly quiet after striking; and, having met the same misfortune in a wooden vessel, I was not at all alarmed for the safety of the ship. It was low-water; the rise being about four or five feet. A stream-anchor was laid out, and we had commenced hauling on the cable, when the carpenter reported five feet in the well, and nothing more was done, fearing the ship would go down in deep water if she came off. In four hours the troop-ship disappeared as far as the mizen mast. No ordinary wooden ship, whether man-of-war or merchant ship, would have been lost through such an accident. She might possibly have lost a few sheets of copper, or a trifle more damage, and at high water she would have come off. It was the remark of all on board that they could not have believed it possible that so slight a shock would have been the means of losing the vessel."

Now, I think we cannot have a more striking case of the uselessness of compartments. This ship ran on forwards, and yet the compartment failed to save her. A slight run up on a rock makes her a wreck in a few hours, and 50,000*l.* or 60,000*l.* is gone, when there is not a wooden ship in the navy that would not have stood twenty or fifty such blows without the slightest danger to her being sea-worthy. He goes on to compare this with the case of a wooden ship:

"I cannot but compare the cases of my striking on rocks in the 'Vixen' and 'Assistance.' In the 'Vixen' we had a gale of wind, and a very heavy sea. We were ten minutes on the rock, and so violent were the shocks that the boilers forced the upper deck up, the rudder was knocked off, and we expected she would have parted, but, having thumped over it, she made at first about a foot of water in four hours, which we reduced to a foot in twenty-four hours by cleaning her out and filling in open spaces from inside. She remained on the station two years afterwards without being docked."

The "Vixen" is one of those flat-bottom paddle-wheels, which you are told would not stand so well as iron, or would not stand thumping like the rising floors. Can any one here suppose that even the "Warrior," for I will take her, if in a heavy sea like that she had beat over a sharp rock, dragging through her bottom, and driving up her bottom so that the boilers lifted the upper deck, can any one suppose that she would not have sunk alongside? I will give a reason why I think so, if she came off. But I also wish to give a reason why an iron ship is much less likely to come off a rock if she strikes heavily than a wooden one. All sailors know if a ship begins to strike heavily, and you either wish to force her over the rock or have got the anchors out to heave her off, that the first thing is to lighten her. You throw over the fresh water, the guns, and everything that can reduce the weight, in hopes of getting her off. Every one will allow that when the plates of an iron ship are perforated by these blows, one or two compartments must at least fill with water. I suppose that in a ship like the "Warrior," one compartment when full of water would alone be something like a thousand tons. Now, if at the very time you want to lighten a ship, at the time she is thumping so heavily, a thousand tons is added by one compartment filling, and two thousand tons by two compartments filling, are you not binding her to the rock, and removing all chance of her getting off? The "Transit" is the fourth case. The "Transit" went on shore in the Straits of Sunda. I have had the particulars of it from one of the officers who was on the court martial. The water was perfectly smooth, and she was only going seven knots. She ran up gently on a rock, but it was through her bottom as she ran on it. One end of her, the end furthest from where the rock was, sunk almost before they could land the troops. Now, I ask any one here, not an

iron shipbuilder, but a sailor, if the Government are justified in sending out troops in ships of that class; is it right to send out important expeditions like that, and trust the lives of the men and the success of the expedition to such ships, on a new and dangerous coast particularly, when if they run on a rock they instantly sink, even in smooth water, going seven knots an hour, when they can have thoroughly strong wooden ships that can thump over twenty rocks and take their troops on in safety? Not only that, but I believe we may have even stronger wooden ships.

We have not, I believe, built ships in the best way (except in very few cases). The diagonal mode of ship-building remains to be tried. We have built the "Terrible," a very large steamer, which has worked for years, and done her work well. We have built the Queen's yacht, and the "Banshee." The West India Company have built a long vessel called the "Solent." They are built without the expensive curved timber of other ships. You have only to import five, or six, or seven-inch straight teak planking from India. With the execption of the keel, stern-post, and the stern, and short straight floors, you can build the ship all of plank, I mean all the sides; and you do away with all the expensive curved timber. I believe that the elasticity of the diagonally built ship, from the experience we have of boats in the navy, will be far greater than that of ordinary wooden ships. You can build those ships slightly for merchant ships; not hollow bottomed ships, as merchant ships are. I know one merchant who is having diagonal ships built. One of his vessels beat on a rock on which an ordinary ship would have gone to pieces, and she brought her cargo home dry. We have that principle to fall back upon.

The result of troop-ships, then, is this: on an average run of six years, the loss has been 40 per cent. Now, suppose our navy of wooden ships had been lost at the rate of 40 per cent. in six years, what would the country have had to pay for it? I have now to make the comparison with the loss of wooden ships in the navy. I will take the two years of the Russian war, because no iron ships have ever had anything like the risk of rocks and the work of rocks that our 30 or 40 smaller vessels had in the Baltic. I take the Baltic, because the fleet were in a dangerous navigation; the danger being caused by granite rocks. I do not know that any one of them went on a sandbank; I think I am right in saying that, during the first six months, every inshore ship was several times on rocks, and some of them twenty or thirty times. One officer told me that one of the new corvettes was three times on rocks in one day, and thumped heavily; any one of which blows would have caused the loss of an iron ship. Now the loss of wooden ships during the two years of the Russian war, out of 200 ships in commission, was that of one ship, the "Tiger;" she got ashore in the Black Sea, and was really destroyed by the fire from the batteries; therefore you might leave her out, though I have counted her. I have only taken into consideration the number of ships, exclusive of small craft like gun-boats; that would have swelled the number very much, and of course reduced the per-centage. I have left out all the gun-boats in the Black Sea and in the Baltic, and for this reason: we have several small iron steamers that have been running about the coast of England and on the coast of Africa. Now, on the coast of Africa a ship rarely gets ashore; it is a blockading station.

The CHAIRMAN.—The "Tamar" was lost there. She ran up on the beach.

Captain SULLIVAN.—I do not know the case. As a rule, it is a safe station, and we do not hear of vessels being lost there. I will set them against the whole of the small gun-boats. I do not include them in this calculation of ships. I only take the old class of ships, down to corvettes and sloops. In the two years of the war, including the whole of the work in the Baltic, we did not lose one wooden ship out of the 70 or 80 vessels in the Baltic. But we had an iron transport ship attending on the squadron; on coming home with the sick she touched a boulder off a point and sank instantly, and all the sick had to be landed on an island. So that, while we had 30 or 40 wooden ships frequently getting on shore without serious injury, that one blow did for the iron ship. Now, as to what wooden ships endure. There was only one ship, the "Valorous," that was not in perfect order to do her work, after all their getting on shore, though there were among them many flat-bottomed paddle-wheel steamers; she had been so often on shore, grinding off her fore-foot and false keel, that at last, striking heavily on a rock, on a part where there was very little wood left, from having struck so frequently, she sprung a bad leak. But she afterwards landed her troops at Bomarsund, and went on with her work for two months, and then came home to be docked. With that exception, all the fleet did their work to the end of the season. I commanded two of the weakest ships in the fleet; one was the old "Lightning," the first steamer built in the navy in

Mutiny, when the loss of the ship was a serious loss. The other was about to embark troops for the Peiho at Hong Kong, on Admiral Hope's expedition the other day. I happen to know an officer that returned, the master of the "Assistance." I wrote and asked him for particulars of the loss of the ship. I may say, as the public press seems to think that naval men are generally in favour of iron ships, that, with very few exceptions, naval men that I have spoken to, since these discussions began, agree with me. A very large majority of them say they are really glad I am working the thing, and that it is perfect nonsense to suppose an iron ship will stand what a wooden man of war will.

This letter is from the master of the "Assistance," a very old naval officer:

"I rejoice to find you are fighting such a good battle with regard to the system of employing iron vessels as troop ships and men-of-war. The 'Assistance' was sufficient to convince me that for all purposes wood must always have an enormous advantage over iron. When the accident happened she was making thirty-eight revolutions, which would give a speed of about seven knots. The water was perfectly smooth, so she remained perfectly quiet after striking; and, having met the same misfortune in a wooden vessel, I was not at all alarmed for the safety of the ship. It was low-water; the rise being about four or five feet. A stream-anchor was laid out, and we had commenced hauling on the cable, when the carpenter reported five feet in the well, and nothing more was done, fearing the ship would go down in deep water if she came off. In four hours the troop-ship disappeared as far as the mizen mast. No ordinary wooden ship, whether man-of-war or merchant ship, would have been lost through such an accident. She might possibly have lost a few sheets of copper, or a trifle more damage, and at high water she would have come off. It was the remark of all on board that they could not have believed it possible that so slight a shock would have been the means of losing the vessel."

Now, I think we cannot have a more striking case of the uselessness of compartments. This ship ran on forwards, and yet the compartment failed to save her. A slight run up on a rock makes her a wreck in a few hours, and 50,000*l.* or 60,000*l.* is gone, when there is not a wooden ship in the navy that would not have stood twenty or fifty such blows without the slightest danger to her being sea-worthy. He goes on to compare this with the case of a wooden ship:

"I cannot but compare the cases of my striking on rocks in the 'Vixen' and 'Assistance.' In the 'Vixen' we had a gale of wind, and a very heavy sea. We were ten minutes on the rock, and so violent were the shocks that the boilers forced the upper deck up, the rudder was knocked off, and we expected she would have parted, but, having thumped over it, she made at first about a foot of water in four hours, which we reduced to a foot in twenty-four hours by cleaning her out and filling in open spaces from inside. She remained on the station two years afterwards without being docked."

The "Vixen" is one of those flat-bottom paddle-wheels, which you are told would not stand so well as iron, or would not stand thumping like the rising floors. Can any one here suppose that even the "Warrior," for I will take her, if in a heavy sea like that she had beat over a sharp rock, dragging through her bottom, and driving up her bottom so that the boilers lifted the upper deck, can any one suppose that she would not have sunk alongside? I will give a reason why I think so, if she came off. But I also wish to give a reason why an iron ship is much less likely to come off a rock if she strikes heavily than a wooden one. All sailors know if a ship begins to strike heavily, and you either wish to force her over the rock or have got the anchors out to heave her off, that the first thing is to lighten her. You throw over the fresh water, the guns, and everything that can reduce the weight, in hopes of getting her off. Every one will allow that when the plates of an iron ship are perforated by these blows, one or two compartments must at least fill with water. I suppose that in a ship like the "Warrior," one compartment when full of water would alone be something like a thousand tons. Now, if at the very time you want to lighten a ship, at the time she is thumping so heavily, a thousand tons is added by one compartment filling, and two thousand tons by two compartments filling, are you not binding her to the rock, and removing all chance of her getting off? The "Transit" is the fourth case. The "Transit" went on shore in the Straits of Sunda. I have had the particulars of it from one of the officers who was on the court martial. The water was perfectly smooth, and she was only going seven knots. She ran up gently on a rock, but it was through her bottom as she ran on it. One end of her, the end furthest from where the rock was, sunk almost before they could land the troops. Now, I ask any one here, not an

iron shipbuilder, but a sailor, if the Government are justified in sending out troops in ships of that class; is it right to send out important expeditions like that, and trust the lives of the men and the success of the expedition to such ships, on a new and dangerous coast particularly, when if they run on a rock they instantly sink, even in smooth water, going seven knots an hour, when they can have thoroughly strong wooden ships that can thump over twenty rocks and take their troops on in safety? Not only that, but I believe we may have even stronger wooden ships.

We have not, I believe, built ships in the best way (except in very few cases). The diagonal mode of ship-building remains to be tried. We have built the "Terrible," a very large steamer, which has worked for years, and done her work well. We have built the Queen's yacht, and the "Banshee." The West India Company have built a long vessel called the "Solent." They are built without the expensive curved timber of other ships. You have only to import five, or six, or seven-inch straight teak planking from India. With the exception of the keel, stern-post, and the stern, and short straight floors, you can build the ship all of plank, I mean all the sides; and you do away with all the expensive curved timber. I believe that the elasticity of the diagonally built ship, from the experience we have of boats in the navy, will be far greater than that of ordinary wooden ships. You can build those ships slightly for merchant ships; not hollow bottomed ships, as merchant ships are. I know one merchant who is having diagonal ships built. One of his vessels beat on a rock on which an ordinary ship would have gone to pieces, and she brought her cargo home dry. We have that principle to fall back upon.

The result of troop-ships, then, is this: on an average run of six years, the loss has been 40 per cent. Now, suppose our navy of wooden ships had been lost at the rate of 40 per cent. in six years, what would the country have had to pay for it? I have now to make the comparison with the loss of wooden ships in the navy. I will take the two years of the Russian war, because no iron ships have ever had anything like the risk of rocks and the work of rocks that our 30 or 40 smaller vessels had in the Baltic. I take the Baltic, because the fleet were in a dangerous navigation; the danger being caused by granite rocks. I do not know that any one of them went on a sandbank; I think I am right in saying that, during the first six months, every inshore ship was several times on rocks, and some of them twenty or thirty times. One officer told me that one of the new corvettes was three times on rocks in one day, and thumped heavily; any one of which blows would have caused the loss of an iron ship. Now the loss of wooden ships during the two years of the Russian war, out of 200 ships in commission, was that of one ship, the "Tiger;" she got ashore in the Black Sea, and was really destroyed by the fire from the batteries; therefore you might leave her out, though I have counted her. I have only taken into consideration the number of ships, exclusive of small craft like gun-boats; that would have swelled the number very much, and of course reduced the per-centage. I have left out all the gun-boats in the Black Sea and in the Baltic, and for this reason: we have several small iron steamers that have been running about the coast of England and on the coast of Africa. Now, on the coast of Africa a ship rarely gets ashore; it is a blockading station.

The CHAIRMAN.—The "Tamar" was lost there. She ran up on the beach.

Captain SULLIVAN.—I do not know the case. As a rule, it is a safe station, and we do not hear of vessels being lost there. I will set them against the whole of the small gun-boats. I do not include them in this calculation of ships. I only take the old class of ships, down to corvettes and sloops. In the two years of the war, including the whole of the work in the Baltic, we did not lose one wooden ship out of the 70 or 80 vessels in the Baltic. But we had an iron transport ship attending on the squadron; on coming home with the sick she touched a boulder off a point and sank instantly, and all the sick had to be landed on an island. So that, while we had 30 or 40 wooden ships frequently getting on shore without serious injury, that one blow did for the iron ship. Now, as to what wooden ships endure. There was only one ship, the "Valorous," that was not in perfect order to do her work, after all their getting on shore, though there were among them many flat-bottomed paddle-wheel steamers; she had been so often on shore, grinding off her fore-foot and false keel, that at last, striking heavily on a rock, on a part where there was very little wood left, from having struck so frequently, she sprung a bad leak. But she afterwards landed her troops at Bomarsund, and went on with her work for two months, and then came home to be docked. With that exception, all the fleet did their work to the end of the season. I commanded two of the weakest ships in the fleet; one was the old "Lightning," the first steamer built in the navy in

1823: she ran at full speed on an unknown rock. Her keel never touched; but a very few feet under water her bow caught the sharp edge of the rock; it threw her over so, as her bilge scraped over it, that we could hardly stand on the deck; but the speed at which she was going took her over it, and she was none the worse for it, with the exception of the torn copper. That blow would have torn the bottom of an iron ship clean out. The last year of the war, I had the worst vessel in the service. She was an old, condemned Liverpool packet. She was built of light scantling, to run from Liverpool to Dublin. After running twenty years she was worn out, and was patched up for the war. Being of light draught, I chose her for the work I had to do. She was repeatedly on shore; but on one occasion, when going nine knots, she ran on a granite rock so suddenly as to nearly throw the people off their legs, and then she ran her bow up two or three feet; two frigates with their steam on and anchors could not start her till she was lightened; yet she never leaked, she did her work till she came home at the end of the season. I have been told by an officer of the "Leopard," one of those large, flat-bottomed, paddle-wheel steamers, that her false keel and part of her main keel was gone; and her bottom was looked at as a curiosity from the way in which it had been torn, from her frequently going on shore in the Baltic. If it was a small vessel, a large vessel would jerk her off the rocks; but we never dreamed of that making them unsafe. Now, if an iron ship had gone on in that way, it would have torn the plates out of her. One of our line-of-battle ships, the "Hastings," went on shore in the middle of the Gulf of Finland, on a bank with bad granite boulders. It came on to blow heavily; they were very much afraid of her, from the heavy way in which she struck. It took two or three large ships to get her off. That vessel was on these boulders for two or three days; and when she was got off she came in and did her work afterwards. I have no doubt a good deal of her copper and bottom was torn. No iron ship in the world, neither the "Warrior" nor any other ship, would have stood that. You must not think there is a great deal of difference between the "Warrior" and others, because, though she is double in her bottom amidships, her bilges are only single iron plate, and if that plate is torn, for at least one compartment, she gets a thousand tons of water into her. Is she very likely to come off a rock then? And is that a class of ship to be sent on to an enemy's coast in a sea-way—to keep close among the rocks off Brest, for instance—watching an enemy's port, when you know if she goes on a rock in a sea-way she is gone? Would you not rather have wooden ships, that you know will do their work well, and if they get on a rock, will come off without much danger?

Now I will take the average loss of wooden ships since the war, to make sure that there shall be no unfair comparison. In the five years since the war we have had 120 sea-going ships in commission. When this list was taken out I had not heard of the loss of the "Wasp," * I only heard of it within the last two or three days; but the loss in the five years out of the 120 ships was, the "Polyphemus" and the "Raleigh." The "Raleigh," I have no doubt, could have been saved if they could have spared ships and men for the work of raising her; but they were urgently wanted for the war in the Canton river. That was the case of a wooden ship striking in a sea-way on a sharp pinnacle of rock; she was able to keep afloat, and to go on for many miles till they found a place to run ashore, and land all the crew. The loss out of these 120 ships is one per cent. in three years and a-half; and if we include the two years of the Russian war, with all its dangers in the Baltic, the loss would be three ships, with an average of 143 ships in commission, or, in seven years, less than it is out of the ten iron ships in six years. Now I do think, setting all opinion on one side, these are facts which ought to make any Government hesitate before they spend the money of this country in building iron-bottomed ships; but mind, I have not touched upon the question of fouling, which at once disposes of them for foreign stations; for home service we could take them into dock and clean them. We know that the "Himalaya" if not cleaned periodically is not fit to go to sea; a very little fouling diminishes the speed one or two knots; but I rather wish to speak only of the question of safety, and I ask you whether, with these facts staring us in the face—the loss of four troop-ships out of ten in six years—I am not justified in saying, that if I had the responsibility I would not venture to send troops in an iron ship.

A very minor point must not, however, be overlooked. We know that iron ships are conducters of heat and cold. The ships have to make tropical voyages. Supposing

* Since got off.

they leave England in winter they have to undergo constant changes from cold to heat. They go into bad climes; they go into gales, where they must be battened down. I am told by good authority that passengers by iron ships suffer much from the heat in hot weather and from the cold in cold weather. That will strike every one as being a probable thing. When you think of the thickness of the sides of a wooden ship, and how effective they are in protecting those inside from heat and cold, it ought not to be overlooked, in sending troops for foreign climes, that their comfort may be very much affected whether they go in iron or wooden ships. But that is a question so trifling, compared with the danger of loss, that I almost doubt whether I should mention it here or not. I will mention one other fact, because it occurred not very long ago, to show how, even in slight cases, where the bow of a ship goes on a rock, how little you can depend upon the compartments saving her.

One of our east-coast steamers, when not going very fast, ran on one of the salient points of a rock. They had stopped her; she was not going at full speed; indeed so very slowly that her own engines backed her off. She was a screw steamer. Now we all know that if a vessel is fixed in the least, the turn astern of the engine has very little effect until we bring the weights aft. This vessel was moved astern by her engines; she was actually coming off the rock when the engineer rushed up, and said "She is filling;" and to save her going down in deep water the master was obliged to go ahead and jam her on the rock to save the people. Why didn't her compartments save her? It was smooth water, she was not very hard on shore. Are we to send vessels out like that filled with troops? I do not say that iron ships may not be made safer if you build them with four or five thicknesses, four or five cellular bottoms, but what an expense it will be, and then they will not stand the thumping that oak and teak will stand. But while we have only this experience to guide us, it is to me, madness to think of putting our navy on iron bottoms or to send our troops over the world in iron ships. We do not save anything by it. The "Warrior," per ton, has cost more than we could build a large wooden ship for. I have been assured, on good authority, that the cost of the largest wooden hull, built diagonally, all of teak, for a powerful frigate, would be somewhere about 26*l.* per ton for the hull. We are told that we build our ships in the dockyards rather dearly; but people in comparing their tonnage forget one item; they forget that ships built on one deck, two decks, or three decks, having the same length and breadth, are of the same tonnage, while every deck adds vastly to the cost. So a three-decker built in the dockyard costs 33*l.* per ton, and people compare that with a merchant ship or mail steamer which has not got all this expensive height of decks. All that must be taken into consideration. When I speak of 26*l.* per ton, I am speaking of a frigate like the "Warrior," a one-decked plated ship. If we were going to build with two or three decks, I dare say they would be dearer. I believe we can build as cheap, if not cheaper, than the "Warrior," a ship with diagonal planking that will wear out, if they have any practice on rocks, half-a-dozen "Warriors" one after the other.

Captain CLAXTON, R.N.—One does not like to say a great deal after what we have heard, for Captain Sullivan speaks with a great deal of experience. He is a very gallant officer; is well-known; has done great service in the Baltic, and he has brought a great many instances before us. I think we could bring just as many instances on the other side, but they would take too much time, as I should require at least two hours-and-a-half to enumerate them; but I have them here in every possible shape and make; instances where iron ships have stood with nothing but their stems or bows hanging on, where a wooden ship would break her back. I do not like to go into that point now; but I think we naval officers do not know so much about iron or wood as we ought to, to enable us to go into the real merits of the case. I hold that an iron ship is infinitely more a mechanical construction than a wooden ship; and I think an iron ship with angle iron is a very strong thing, the very best thing when we have filled her up; but a wooden ship consists of a parcel of planks only, kept tight by caulking. We often hear of the butts being started, the butts of the bow and the butts of the stern. I think we ought to know a great deal more about them before we enter into that subject, because we speak before iron-ship builders, who are present. I could mention a great many facts which have come under my own observation, of iron ships that have had their compartments filled, and have come off perfectly well. The "Vanguard" was a week, thumping on rocks, on the coast of Cork. None of us can deny any of these facts. But Captain Sullivan makes his case very strong, inasmuch as he states that iron ships disappear after striking, and go down. That, in my opinion, proves the

strength of the iron-ship. He says a wooden ship would have shown chips on the sea if she had been wrecked. Well, take the case of the "President," she sunk, and has anybody ever heard of her after she sunk?

Captain SULLIVAN.—She was burned.

Captain CLAXTON.—I believe she struck on St. George's Bank, because she was very near St. George's Bank. However, I think the best possible thing is to keep both wood and iron off rocks. That is my opinion; and that I think is one part of the business which belongs to captains, to see that the mates and men do their duty. That is one of the best points in the whole thing. My opinion is that iron is very much stronger than wood. Captain Sullivan has mentioned instances of transports having gone down, but what sort of transports were they? I should like to know by whom they were built, and of what sort of iron they were built; whether they were built of cheap iron, and whether they were built honestly and well, because there are a great many ships that are little better than tin kettles—something like the "Ruby;" she was so thin that she would not stand a shot. I have had a great deal of experience with iron vessels. There is the "Great Britain," which was built by my friend Mr. Brunel, and went ashore at Dundrum Bay. The other evening Captain Sullivan did allude to her, and stated that she was protected whilst she was there; but she was there all October, November, December, and January, unprotected.

The CHAIRMAN.—What was she on?

Captain CLAXTON.—On rocks.

Captain SULLIVAN.—I particularly alluded to the fact that she was not protected, but that she was borne on sand her whole length, except on one point, where there was a rock.

Captain CLAXTON.—In all the history you gave about the ships in the Baltic, you speak from your own experience. I speak from my own experience of the Great Britain. The Great Britain was on rocks; she was on sand when she struck; but when the sea came up and broke round her it washed away the sand, and it left her borne on rocks right in the middle, and she was thus suspended on a rock in the middle, with nearly 180 feet unsupported at each end. That ship never altered her form, so that you could not get the end of a pen-knife into the water-ways where they were joined; and that ship, after thumping there eleven months, came off,—and what is she doing now? Why, every year she is taking passengers at a remarkably great speed to Australia; she has carried 25,000 troops; she was employed to go to India; she took 5,000 troops to the Crimea in three trips; and she is going on still. There is one point which I wish to advert to. Captain Halsted dwelt very much on the first Board of Admiralty that employed the screw, and gave the credit to Sir George Cockburn. I am not going to disagree with him, but I am going to state that the first Board of Admiralty that ordered the screw was Lord Minto's Board, in the "Rattler," and it was Lord Haddington's Board that carried it out.

Admiral CARNAC.—I only wish to corroborate the statement which has just been made by Captain Sullivan with regard to the heating of iron ships. One of the ships belonging to the East India Company heated to such a degree that illness took place on board, and I believe some deaths, and they were actually obliged to heave that vessel broadside on to the north-east wind to cool her, and keep her there twenty-four hours.

Mr. SCOTT RUSSELL.—I wish to ask Captain Sullivan a question, if you will allow me—as he has quoted the "Birkenhead" very often, why did he not quote the "Avenger?" I would just ask that question.

Captain SULLIVAN.—I have not the slightest objection. The cases are totally different. A ship in a heavy gale of wind, running before a sea with sail and steam on, struck on a sharp pinnacle of rock in an ocean seaway so heavily that the sea broke over her rapidly, drowned or washed the people off her decks, and one boat only escaped from her; a great part of the vessel was afterwards found sticking on the rock. That was a case of a gale of wind at sea. The case of the "Birkenhead" was nothing of the kind. The "Birkenhead" had no sea to wash anybody off her; the boats were lowered and the ladies put alongside; there was nothing but a little swell; it was beautiful weather, and she was not so hard up but what her engines took her astern, but in going astern the very rocks ripped out the plates; she filled, and sunk clear of the rock. The two cases are not parallel. One was a heavy gale of wind which would have broken up the biggest ship in the world.

Mr. SCOTT RUSSELL.—I only would submit this: Capt. Sullivan has said that he

would only quote facts. Now, I would only observe that, whenever Capt. Sullivan quotes a fact, he also quotes along with it, under the title of fact, such a quantity of personal opinion that it is extremely embarrassing to know where the opinions begin and where the facts end. Gentlemen, it is a very old dodge in argument to call your opinions facts, and to call your opponent's facts opinions. Now, I put it to you whether the description Captain Sullivan has given of the calm, beautiful sea, and of everything made right, and smooth, and comfortable for the "Birkenhead," so that she could not have gone down, and then this dreadful state of things, in which the poor "Avenger" could do nothing but go down, although he has been telling us all this evening that, if a good, honest, well-built ship, all built of wood, had gone on a rock under such and such circumstances as an iron ship went on, she could have stood every bumping for hours, and have been rather the better for it than worse—I put it to you whether he has not described these ships in the most glowing colours whenever it was necessary to do credit to a wooden ship, and whenever it was necessary to do discredit to an iron ship whether he has not taken the trouble to give the circumstances with such a colour as, I can say, carries no conviction to my mind. I have built (I will not say as many, but I have built) nearly as many wooden ships as iron ships. I began with wooden ships, and it so happens that the last four ships I have built have been wooden ships; therefore, perhaps, Captain Sullivan will allow me to take myself out of the category of mere iron-ship builders, and will allow me to give a plain, simple judgment, as he has given a plain, simple judgment. And I can say this: I have known of my own knowledge (it is too late to give you instances, but I should be happy to do so) a greater number of my own iron ships go on shore, bump on rocks, get into collisions, and come off safely, than I have known of my wooden ships under the same circumstances. I am of opinion that, if Captain Sullivan had taken half the pains he has done to quote instances of wooden ships getting upon rocks and going down, and of wooden ships not getting upon rocks at all, but getting into heavy seas and going down, and never being heard of again, he could have brought ten instances of wooden ships for one that he has brought of iron ships. I beg to say one point further. The "Birkenhead" is always quoted—always coming up. We all know about the "Birkenhead." Why did not Captain Sullivan quote the "Sarah Sands," a vessel half burnt out at sea, and the other half of her brings every soul on board to port?

The CHAIRMAN.—In order to shorten the discussion, I think Captain Sullivan's point is "rocks." The "Sarah Sands" is a case of "fire." That is the distinction.

Mr. SCOTT RUSSELL.—She was also loaded with gunpowder. Perhaps I was taking too large a view of the subject. We will go to rocks if you like, because those are the rocks on which it is quite plain Captain Sullivan would like to put all the iron ships. It so happens that I built two iron ships which were used in the late war. It so happened that one of them did get on rocks in the Bosphorus; that one of them did rip her bottom up; that one of them, having ripped her bottom open, took herself into the docks at Constantinople, repaired herself, went out, and did an immense deal of service afterwards in the Sea of Azoff. It so happened that another iron ship built by me went through a great deal of service, equal to perhaps twenty or thirty times her own cost; she went on rocks, and so bumped her bottom that, when she came home here, I was sent for in a great hurry to see her bottom. What do you think I found? I found forty-two large indentations made by the rocks in her bottom, and out of forty-two indentations there was only one that had a crack to admit the water. That is the case of two iron ships. Now, these are cases which Captain Sullivan had access to as much as I had.

Captain SULLIVAN.—I beg your pardon. I had no means but what I have taken from the "Navy List." I have had no means of going to any public office. I have no means beyond that of any private individual. I took the cases from the "Navy List."

The CHAIRMAN.—If you give us the names, we shall be able to balance the one against the other.

Mr. SCOTT RUSSELL.—No; you will not be able to balance one against the other, because Captain Sullivan has taken infinite pains to get the instances on his side, and I have not taken any pains to get instances—I have only given those which I happened to know. I will give you other instances. I have built four steamers of wood for a large company—the West India Company—and out of the four steam vessels of wood which I built for them it does so happen that two of them went on shore; the two of them never came off shore, and the two other of them were utterly shipwrecked. Now, what sort of argument would it be to present to this meeting if I were now to

say to you: "Gentlemen, there are my two iron ships; you see they both got on shore; they both bumped on rocks; they both got on shore in circumstances when any wooden vessel would certainly have gone down?" If I were to say that, it would be only saying what Captain Sullivan has said about the wooden ships: "There are my two wooden ships; no sooner did they get on a reef but they went to pieces." If you will put a thoroughly good iron ship and a thoroughly good wooden ship, and set them both on the same shore and in the same circumstances together, and show us that one goes down and the other survives—that is reasoning, and that is argument. I say that all these things that Captain Sullivan has told us to-night as reasons, comparisons, and facts, are reasons, comparisons, and facts from which no conclusion can be drawn but that one vessel in one set of circumstances goes down, and some other vessel in another set of circumstances survives. That is the only conclusion I can deduce from all these facts. I will not take up your time any longer.

Captain SULLIVAN.—I would say one word in explanation—that in bringing forward these instances I had not the slightest bias. I brought them forward fairly, as facts; and as to their not being fair comparisons, I took the case of the officer's letter that I read, of a ship running quietly on shore in smooth water in harbour, and the other case, of the "Transit," running on shore in smooth water in harbour with little speed and no sea, and I think those two cases will not bear the construction which Mr. Scott Russell has put upon them.

Mr. GRANTHAM.—May I add one word with respect to this bugbear the "Birkenhead," always dragged forward by every opponent to iron ships. As I know something of the history of that case, I think it should not go forth without some word of explanation. She was built at a time when but little attention was paid to making the bulkheads. Captain Sullivan knows the fact, for it is to be found in a Blue-Book lately given in evidence in the House of Commons. He is there describing a great defect in iron bulkheads; I believe he gave the evidence very recently. This "Birkenhead" was built about fifteen or sixteen years ago. Captain Sullivan describes very correctly and very happily the mode then common of securing bulkheads. It is quite appropriate to our subject, because he has alluded to compartments. He says, "Ships are nearly cut asunder by the introduction of bulkheads in the same way as postage-stamps are stamped out ready for tearing." This Captain Sullivan has given in evidence as the system adopted for bulkheads; it was perhaps the system adopted in the "Birkenhead." I did the same once in a ship that I built many years ago, and to my great horror I saw the ship was nearly cut asunder. I did it inadvertently, and did not perceive it till too late. The "Birkenhead" may have been treated in the same way. A few ships were built incautiously in that way, but no ship-builder of any common sense or judgment would do such a thing at this time; therefore, to say that that system is inseparable from bulkheads, is simply to put the matter in a wrong light. If a man built a ship in such a manner in these days, I should say nobody ought to give him an order to build another; it is a mode so reprobated by all ship-builders. With regard to ships not being saved by compartments, I have three cases in my memory of vessels designed by me, in which I have the very comfortable reflection of thinking that no less than about 500 lives were saved by these very identical intermediate bulkheads, where the ships have been full to the level outside, in the one case in the after-hold, in the other case in the engine-room. I believe every shipbuilder could tell you stories of a similar kind, where ships have been saved by the intermediate bulkheads in the centre of the ship. I took great pains to make these bulkheads safe, and, unless they had been thoroughly trustworthy, those ships must have gone down, and all the lives have been lost. I may instance the "Sarah Sands," where I took great pains to put one of the aft bulkheads in. She was burned, as you all know; she had an explosion of gunpowder that blew out her stern; she then, with 400 people on board, had a gale of wind for ten days, the water inside of the ship frequently level with that on the outside, and yet she saved all these people.

The CHAIRMAN.—She was not a man-of-war.

Mr. GRANTHAM.—She was a transport. It simply goes to show that the intermediate bulkheads are of very great value. I believe, if judiciously done, they will counteract that tendency which iron ships have of being easily penetrated by rocks.

Captain HALSTED.—As reference has been made to the routine case of the "Birkenhead," I may state there was a very similar case which took place recently, the case of the "Thunderbolt." The rock which struck the "Thunderbolt" so thoroughly pierced her side, that it pierced her tank.

The CHAIRMAN.—But I think, in the case of the "Thunderbolt," she had time to put steam on and get on the beach.

Captain STOPFORD.—In the case of the "Avenger," I believe it was blowing so hard that the funnel fell over the mast before she broke up. Her bottom was so completely broken up, that a part of her was found on the coast of Sicily. She did not go down; she went to pieces.

Captain SULLIVAN.—There is one point which I entirely forgot. Not long since in the dockyard at Woolwich, they were scraping one of the iron store-ship's bottoms, a comparatively new ship; and as they scraped the dirt off her, 600 rivets dropped out, only kept in by the dirt and the external pressure of the water.

Mr. SCOTT RUSSELL.—Captain Sullivan has simply proved what I hoped I was going to prove,—that the vessels, of which he has quoted a list, were probably the worst vessels the world has ever heard of, and that these very transports which he is now talking of were unworthy the name of good ships. If all these rivets really were in that state, there is no doubt whatever that those transports that were lost were well lost, and the question must hereafter be, what sort of iron transports will be selected.

The CHAIRMAN.—Mr. Grantham, you have alluded to the iron ships sailing from Liverpool to the East. Have you ever heard of an iron ship bringing home a cargo of tea?

Mr. GRANTHAM.—I fancy they are very much employed in that trade.

Evening Meeting.

Friday, May 31, 1861.

Captain M. S. NOLLOTH, R.N., in the Chair.

DE BATHE'S AND LYNALL THOMAS' ARMOUR-PLATES.

By Lynall Thomas, Esq.

Having attended the discussion at the Institution of Naval Architects without having had an opportunity of taking part in it, I avail myself of this opportunity of exhibiting and explaining a method of affording resistance to the penetration of shot and shell into the sides of a ship, which may perhaps be worthy of your consideration, as I believe, from long and earnest consideration, added to considerable experience, of the effect produced by shot generally, that the solid iron plate on a coating of timber, as adopted in the general service, is one of the worst which could be conceived. My chief reason for this opinion is, that the whole force of the blow coming at once upon the plate, its effect is felt instantaneously through the whole thickness of the plate in the direction in which the shot is moving. An immense thickness of metal is therefore required, and consequently an enormous weight upon the sides of, and strain upon the vessel generally; the joint efforts of which make the remedy almost as bad as the disease. With respect to the strength afforded by the wooden back, I have to observe, that in all my experiments I have found the wooden foundation to favour rather than prevent the penetration of the shot through the iron plate. There are several methods for preventing the penetration of shot or shell into the sides of a ship. 1st. By constructing these sides entirely of iron, thus opposing plates of solid metal to the impact of the projectile. 2nd. By sloping the sides in such a manner as to deflect the projectile. 3rd. By covering the sides with some substance which shall receive the first impact of the projectile, dispersing the force before complete penetration can take place.

The objection to the first of these methods is, that with the continual improvements in the means of attack, so great a thickness of metal would be required, that no ship could carry it without great detriment to her sea-going qualities.

With regard to the second method, namely, the sloping sides, the same objection holds good; for, although a less thickness of metal might be found sufficient to divert the blow of a shot when fired at ships thus constructed, unless under certain circumstances, yet such vessels must, of necessity, lie so low in the water, that in engaging land batteries or vessels much higher out of the water than themselves, the sides would be liable to penetration, unless the metal plates were of a thickness identical with those required for a vessel of an ordinary form, so that a still greater weight of metal would

be necessary, inasmuch as more would be required to cover a sloping than an upright side, the surface being greater.

Up to the present time, I believe that the efficiency of the sloping side has only been tested with "round" shot, which are more easily deflected by the slope than flat-headed shot of an elongated form, for the following reason. The ordinary sperical shot only preserves sufficient force to penetrate an "ordinary" iron plate (*i. e.* 4 inches) for a short portion of its flight. Consequently, unless at point-blank distances, it is useless to attempt to penetrate an iron plate with round shot. With a heavy elongated shot, however, this penetration could be accomplished from a greater distance.

Now, supposing the gun to be fired with some elevation, the sloping sides would be rather favourable to penetration than otherwise, in proportion as the angle of the shot's descent approached that of the sloping side.

It has hitherto been a received opinion that the axis of an elongated shot remains always parallel to itself during the shot's flight, in which case its penetrative powers would be considerably decreased as the distance of the object struck increased. This, however, is not necessarily so. An elongated shot may be so constructed that its axis shall remain a tangent to the curve throughout the whole flight, so that such projectile will always fall point foremost on the object struck.

This has been proved by experiment, in a manner which placed the truth of it beyond a doubt. In fact, I myself made the experiment with a 7-inch rifle gun at Shoeburyness.

What I have just stated shows that the thickness of metal for vessels constructed with sloping sides cannot safely be diminished.

Should the vessel roll (and who can assert that they will not, and that heavily) where will be the use of the sloping sides?

When the guns have to be worked on the top of the sloping sides, the effect of the ricochet of the broken shot, &c., from what may well be called an iron glacis, will probably be most destructive.

The third method, namely, that of dispersing the force of the shot before the latter has time to penetrate the sides of the vessel, appears to me to be the one likely to be attended with the greatest efficiency, convenience, and economy. The "Warrior," and other iron-cased frigates, are examples of this principle in its most primitive form. These vessels have wooden sides, and to prevent the penetration of shot they are simply coated with plates of iron.

The proposition to construct the sides of the vessel with iron, placing wood outside as a protection, is the same in principle, and would doubtless be more efficient in preventing the complete penetration of solid shot; but the facility with which a coating of wood, or indeed of any soft substance, would be destroyed by shells, puts this method out of the question. I entertained the above idea some time ago myself, but discarded it for the reason I have mentioned.

With respect to the wooden vessel coated with solid iron plates, there appear to be several almost insurmountable objections to their permanent adoption. In the first place, it would appear to be necessary, after a ship of this description has been laying up for some time, that she should be stripped of her armour from stem to stern before she can be honestly pro-

nounced fit for service again. Furthermore, in order to ensure the requisite protection, the iron would have to be nearly, if not quite, as thick as if she had no wooden sides at all.

The method which I have now to submit to the consideration of this meeting is one which I believe will be found better calculated to attain the desired ends than any of those which I have mentioned. It is, I believe, quite a new idea, and consists of protecting an iron vessel with iron armour. This armour, to which we have given the name "louvre-plate," on account of its similarity to a louvre-board, or, what will be more easily understood by most, a "jalousie blind," is the joint invention of Colonel de Bathe and myself, and is the result of much careful consideration, coupled with some knowledge of and experience in the effect of heavy rifle projectiles.

The diagrams will show more fully the arrangement and disposition of the metal, and may be thus briefly described. Upon the sides, say 2½ or 3 inches in thickness, of an iron vessel, are placed the plates one above the other in the manner shown, leaving an interstice between each which might advantageously be filled with an elastic substance, such as New Zealand flax, junk, &c. In this instance the plates are supposed to be 2½ to 3 inches thick, and the interstices 1½ inch; but this, as well as the thickness of the plates, is arbitrary, and will depend entirely upon the size of the vessel and upon the relative protection which it may be considered desirable to afford her.

By this means we get rid of a very large portion of weight; in fact, reckoning that of both the iron and wood, in such ships as the "Warrior," the weight would be over one-fourth less.

It will be perceived by this peculiar disposition of the metal, that the force of a shot's impact is felt,not in the direction of its flight, as in the case of a solid plate, but at the point above it, and therefore the effect upon the hinder plate is enormously reduced. Very little solid resistance is offered to the first impact of the shot; but the quality of elasticity, so largely possessed by iron, is made subservient to resisting the effect of impact in a very great measure.

I would further draw your attention to several other advantages which this arrangement possesses in a high degree, one of the most important of which is the ease with which any damage may be repaired by means of spare plates; so much so, that a vessel may carry them and repair her damages at sea.

Again, the effect caused by a shot striking the side is confined to a smaller space than is the case when a large solid plate is struck (more especially when the plates are not penetrated), since the whole plate, which may have a surface of 70 or 80 square feet, is affected by the blow. An elongated shot, from the unequal resistance which it would encounter upon its fore-end, would have its penetrating power very much more lessened in striking plates of this kind, than in striking those presenting a surface offering a uniform resistance, from the greater ease with which the equilibrium of their axes would be destroyed. It will however, I believe, be found impossible to entirely prevent the sides of a vessel being penetrated by solid shot. There is a limit to the thickness and weight of iron which a ship can carry; but the limit to the weight of the projectile, and the

force with which it can be driven, has not yet been reached. All we can at present hope to do is to prevent the penetration of the very destructive elongated shells which are now coming into use. The best course to be pursued, as it appears to me, would be first to ascertain what extra weight ships of each class could carry on their sides without much impairing their sea-going qualities, and then to distribute that weight of metal in the most efficient manner for her protection.

The experiments made upon the "Trusty," as described by Captain Halsted, although extremely valuable, I look upon as being far from a conclusive proof that that description of plate would afford so great a protection to ships as alleged. In this instance, *single* guns only were fired each time at her. Now, in order to form a correct estimate of the efficiency of these plates, or, indeed of any method of protecting ships of war, the vessel experimented upon should be moored, or placed in a position where a large frigate could steam past her, delivering her broadside as in action. It is highly probable that the effect produced by two or three shots striking the same plate simultaneously, would prove more destructive to it than if it were struck by them at separate intervals. Two or three broadsides of heavy guns well delivered, at a distance of 50 or 100 yards, might possibly from the sheer force of the concussion so damage or loosen her plates that a few well-directed shots might suffice to place her at the mercy of her antagonist.

It has been stated that a solid 4-inch plate offers a greater resistance than four 1-inch plates placed apart—that the resistance, in fact, is as the square of the thickness; that is, in the case of the 4-inch plate, this resistance is as of sixteen, whilst with the four 1-inch plates it is only as of four. This is perfectly true as regards the punching machine, or any similar continuously exerted force; but quite erroneous with respect to a shot's impact. A punching machine of sufficient power to punch a hole in an inch plate will not only punch holes with equal facility through four, but through four hundred, if necessary; but a shot may penetrate an inch plate, and not be able to penetrate two placed one behind the other. One is a question of continued pressure on the inch, the other of impact and velocity. Solidity only would resist a large continuous pressure; but the effect of a shot's impact will be impaired by any diminution in its velocity; and the velocity may be diminished in various ways—in fact, it begins to be diminished the moment the shot leaves the muzzle of the gun.

I grant that, if these louvre-plates were placed under a punching machine of sufficient power, they would be penetrated much more easily than a solid plate of the same thickness, because, in the punching machine, *time* is of no account; but the time which would be required to bend these plates down is of immense importance in destroying the effect of a shot's impact, since it would cause the force of the shot to be rapidly dispersed in each direction.

Although, in the experiments which have been made against iron plates, the form of the projectile, and the metal of which it should be composed, are questions of great importance, I hold that they have engrossed an undue share of attention, and that scarcely sufficient regard has been paid to the force of propulsion. At short distances, the form of the projectile is of small importance compared with the degree of force which is employed

in its projection; thus, with a gun of a given weight, I believe it will be found to be of more importance in close action to employ a heavy charge of powder and a lighter projectile, than a heavier projectile and light charge of powder; for it must be remembered that it is the propelling force, *i. e.* the charge of powder, which drives the shot through. Now, although the charge for rifled cannon is a comparatively limited one, because, when exceeding a certain proportion, the shooting becomes wild, yet, at short distances, where great accuracy is not of so much consequence, a very heavy charge may be used with great effect. It has been proposed to increase the weight of projectiles employed against iron plates, diminishing the charge of powder. Now, were it an easy matter to penetrate *both* sides of an iron ship, this proposition would be reasonable; but, in the present state of affairs, it is altogether an erroneous idea. In support of what I have stated with regard to the effect of a shot's impact, I will quote a passage from Sir Howard Douglas's valuable work, "Naval Gunnery," page 77:—

> If an oblong shot, twice the weight of a round shot of equal diameter, be fired with the same charge, the velocity of the former will be less than that of the latter, in proportion as the square root of the weight is greater; that is, the weight being as 2 to 1, the velocities will be as 1 to $\sqrt{2}$. But the effect of impact, measured by the volume of penetration, being as the weight of the shot and the square of its velocity, it follows that with equal charges the effect of the oblong shot will be just equal to that of a round shot of equal diameter.

From the above, therefore, it is evident that the charge of powder being constant, no additional weight in the projectile will increase the effect of its impact. The reason why the 68-pounder 95-cwt. gun has not yet been superseded in our naval service, lies in the simple fact, that a charge of 16 lb. of powder can be fired from it, and neither Sir William Armstrong nor Mr. Whitworth have been able hitherto to produce a gun capable of surpassing it on this point. With a view of beating the heaviest smooth-bores in the service upon every point, I have had a rifle gun constructed upon a principle of my own, from which a charge of 21 lb. of powder can be fired with perfect ease and safety, and with projectiles of any weight, from 120 lb. to 180 lb. or more, as may be deemed most advisable. It may, perhaps, have come to your knowledge that this gun has already been tried with very remarkable results, and a further trial is about to take place.

On the first occasion the charge was increased from 21 lb. to 28 lb. of powder, the projectiles being 175 lb. in weight. Nine rounds were fired, chiefly with a view to test the strength of the gun, and upon this, as indeed upon every other point, the result was most satisfactory. In order to try the gun (which I may here observe loads at the muzzle) to the utmost, three rounds out of the nine were fired at an elevation of $37\frac{1}{2}°$; two with 25 lb. and one with 28 lb. of powder. The range attained was very nearly six miles, and the penetration into the earth totally prevented the recovery of the shot, and could not be ascertained; the time of flight of these shot was from 37″ to 40″. No iron plate which has yet been placed on on a ship's side could I think resist the impact of a shot from this gun at any distance within 2,000 yards or more; and if Sir Howard Douglas's method of calculating the effect of the impact of shot be (as it doubtless is) correct, these shot would have the same force at any point

Fig. 1.

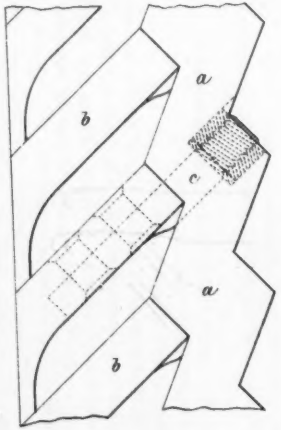
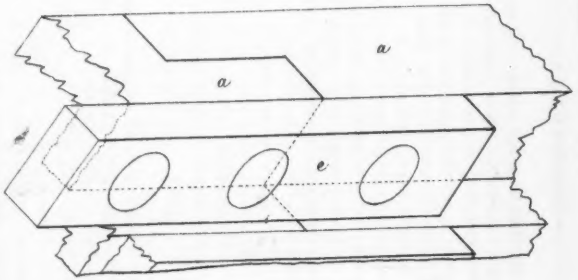


Fig. 2.

Fig. 3.

Fig. 4.



J.R.Johhins.

within that distance, as that of a 68-pound shot when it first leaves the muzzle of the gun, since the mean velocity of flight in passing over a distance of 2,150 yards was exactly 1,200 feet a second, the time of flight being 5·31 seconds. I believe it is in contemplation to arm the "Warrior" and ships of her class with thirty-six 100-pounder Armstrong guns, which are of about 4 tons each, whilst the gun I have just mentioned is of about 6 tons. Now it appears to me that twenty-four guns of this description would prove a much more efficient armament than thirty-six of the Armstrongs, which have not shown much power against iron plates. There would be besides several advantages attending such a change. One of which would be, that two portholes only would be necessary where there are now three, and that in the future construction of this class of vessel the parallel sides would require to be of less length by 90 feet, since the same intervals only (15 feet) would be required for the purpose of working the guns. Those who heard Mr. Scott Russell's most interesting lecture at the Institution of Naval Architects will both understand and appreciate this suggestion.

But to return to the subject more immediately under discussion, I would remark that I believe no sea-going vessel can carry plates of any description which shall render her sides proof against the penetration of solid shot, and therefore that these vessels should only be protected as far as may be possible, without depriving them of other and vitally important qualities, and this, I believe, may be done in a manner to prevent the penetration of incendiary and explosive projectiles of a very heavy description, by some such distribution and arrangement of the metal as that which I have now the honour to introduce to your notice.

A powerful armament and great speed are matters of the very highest importance, and not to be lightly sacrificed; in fact, an iron-cased vessel wanting these qualities would present a mere inert target to a more active and better-armed opponent; and her certain capture and destruction would be simply a question of time. A ship of war is commissioned to "burn, sink, and destroy," and not simply to save herself from being burnt, sunk, or destroyed. In conclusion, I would remark that, having no experience in ship-building, but having had great experience in the effect of shot upon various materials, I have regarded the sides of a ship in this question in the light simply of a protection against destructive missiles, that is, in what manner the greatest protection can be afforded with the employment of the smallest possible weight.

The following is an explanation of the plate:

Fig. 1 represents a transverse section of the side of an iron ship protected by the armour-plates, *a a* being the side or skin of the ship of a zigzag form; *b b* the outer or "louvre" plates; *c* is the bolt which fastens the latter on to the former. The spaces between the louvre plates may be filled with some elastic substance.

Fig. 2 gives a front view of the bolt *c*.

Fig 3 shows the manner in which the inside plates are connected one with another in a longitudinal direction, *d d d* being the rivets, which are placed at certain intervals apart.

Fig. 4 is a front view of the vertical join, *a a* being the plates which

form the side of the vessel, and *e* the plate which is placed at the back to strengthen them at the joint. This plate is also made fast with three rows of rivets.

In reply to various questions, Mr. Thomas stated that the gross weight involved in the proposed form would be one-fourth less than, and, according to the calculations of a well-known Iron Company, the expense about one-half (25*l.* instead of 50*l.* a-ton) the expense of the "Warrior,"—that the saving would result chiefly from all the plates being rolled at the cost of about 8*l.* a-ton, whereas the "Warrior's" plates are very expensive, especially where there is tongueing and grooving,—that repairs could be made with great facility, without disturbing any but the injured parts. The width and thickness of the armour-plates would be adapted to the size and tonnage of the vessel. It will be impossible to give a small vessel a protection equal to that of a large vessel; the effect of the shot's impact is diverted, so that the blow upon the inner plate is not felt in the direction in which the shot is moving, but at a point above it, which considerably lessens the destructive effect. The spaces between the plates may be packed or not with some elastic substance, but the packing was objected to as giving rise to the deposit of a great deal of moisture. The inside plates of iron, or skin of the ship may be flat instead of a zigzag form, but the latter offers a better resistance to shot.

The Chairman conveyed the thanks of the meeting to Mr. Thomas for his interesting and instructive paper, and the proceedings then terminated.

Evening Meeting.

Monday, June 24th, 1861.

COL. P. J. YORKE, F.R.S., in the Chair.

NAMES of MEMBERS who joined the INSTITUTION between the 17th and 24th June, 1861.

LIFE.

Browne, Henry, R., Lt.-Col. 87th Royal Irish Fus. 9*l.*

ANNUAL.

Arkwright, A. P., Comr. R.N.. 1*l.* Greville, A. C., Major Unatt. 1*l.*
Le Geyt, W. B. Esq. Assist. Mil. Storekeeper, Cape of Good Hope.

ON THE INFLUENCE OF ATMOSPHERIC PRESSURE UPON THE BURNING OF TIME-FUSES.

By E. FRANKLAND, F.R.S.,
Lecturer on Chemistry at St. Bartholomew's Hospital.

[Abstracted from a paper read before the Royal Society, June 20th, 1861, entitled "On the Influence of Atmospheric Pressure upon some of the Phenomena of Combustion."]

WHILST engaged in some experiments on the influence of atmospheric pressure upon the rate of combustion of candles, which were found to burn with the same rapidity on the summit of Mont Blanc as in the valley of Chamonix, Colonel Philip Yorke directed my attention to some analogous experiments with the time-fuses of shells, made in India by Quartermaster Mitchell, and which led to a different result. These latter experiments are described in a letter dated Jan. 6, 1855, an extract from which appeared in the Proceedings of the Royal Society.* Quartermaster Mitchell found from a series of carefully conducted experiments, that the rate of combustion of time-fuses was subject to considerable retardation, which he attributed to the diminution of atmospheric pressure at elevated stations causing a more scanty supply of oxygen. The following is a short statement of the results of these experiments, in which three-inch fuses were burnt under different atmospheric pressures.

	Height of Barometer at 32° F.	Elevation above Sea-level.	Time of burning.
1. Average of 6 Experiments	29·61 inches	. .	14·25 seconds.
2. " 6 "	26·75 "	3,000 feet	15·78 "
3. " 4 "	23·95 "	6,500 "	17·10 "
4. " 2 "	22·98 "	7,300 "	18·125 "

* Proceedings of the Royal Society, vol. vii. p. 316.

Comparing the amount of retardation with the corresponding reduction of pressure, we have the following results:—

Numbers of Experiments between which comparison is made.	Diminution of Pressure.	Retardation of Combustion.
1 and 2	2·86 inches	1·53 seconds
2 „ 3	2·80 „	1·32 „
3 „ 4	·97 „	1·025 „

Although these results are perfectly compatible with those obtained with candles above alluded to, yet the subject seemed to me of sufficient technical importance to warrant a repetition and extension of these experiments in artificially rarefied air. With this object in view, a large iron cylinder was connected on the one hand with an air-pump, and on the other with a piece of gas-pipe six feet long and four inches internal diameter, the opposite end of the pipe being furnished with an arrangement by which the end of the fuse to be ignited could be introduced air-tight within the pipe, whilst the closed end of the fuse projected about two inches into the external air. The fuses were ignited at a given instant by a voltaic arrangement consisting of ten cells of Grove's battery, an instantaneous contact-maker, and a piece of thin platinum wire which was inserted into the priming of the fuse. In order to ascertain with precision the moment when the deflagration was finished, the lateral hole at the posterior end of the fuse was bored through to the opposite side; a piece of thread was passed vertically through this aperture and secured above to a convenient support, whilst an iron ball was affixed to its lower extremity at a distance of a few inches above a metallic plate upon which the ball fell when the fire reached the thread, thus indicating the moment when, under ordinary circumstances, the fire of the fuse would be communicated to the contents of the shell. The pressure was indicated by a mercurial gauge inserted into the gas-pipe.

The experiments were made with six-inch fuses (for which I was indebted to the kindness of Mr. Abel, the Director of the laboratory at the Woolwich Royal Arsenal) in the following manner. The fuse being inserted into the end of the gas-pipe, and the necessary degree of exhaustion in the iron cylinder and pipe having been obtained, the fuse was ignited at a given signal. During the continuance of its deflagration an assistant worked the air-pump, so as to prevent any great rise in pressure, whilst another observed the vacuum gauge at the moment when the iron ball dropped. The mean between the pressure at the commencement of the deflagration and that at the end, was assumed to be the mean pressure under which the fuse had been burnt; but it is obvious that this assumed mean pressure can only be approximative, although the gauge fell very regularly and gradually during the continuance of the deflagration.

The following results were obtained:—

Barometrical Pressure * or Mean Pressure.	Time occupied in the Deflagration of each Fuse.
1. 30·4 inches	31·0 seconds
2. 30·4 „	30·0 „
3. 30·4 „	30·0 „
4. 28·4 „	32·0 „
5. 28·1 „	32·5 „
6. 25·55 „	35·0 „
7. 25·85 „	34·5 „
8. 22·35 „	38·0 „
9. 22·55 „	37·5 „
10. 19·90 „	42·0 „
11. 19·40 „	41·0 „
12. 16·15 „	46·0 „
13. 15·75 „	45·0 „

It will be seen from an inspection of the above numbers that, after the three first experiments at atmospheric pressure, an attempt was made to burn two fuses at the same pressure; but, owing to the gauge sinking to the extent of about two inches during the deflagration, the mean pressures at which each pair of fuses was burnt never exactly coincided. For the purpose of comparison, however, it will be convenient to take the mean, both of the pressures and times of burning, of each pair, and to express the results as follows:—

Average Pressure in inches of mercury.	Average Time of Deflagration of 6-inch fuse.	Increase of Time of burning over preceding Observation.	Reduction of Pressure corresponding with increase of time.	Increase of Time for each diminution of 1-inch pressure.
30·40	30·33 seconds	. .	. .	. .
28·25	32·25 „	1·92 seconds	2·15 inches	·893 seconds
25·70	34·75 „	2·50 „	2·55 „	·980 „
22·45	37·75 „	3·00 „	3·25 „	·925 „
19·65	41·50 „	3·75 „	2·80 „	1·339 „
15·95	45·50 „	4·00 „	3·70 „	1·081 „

There are here evident indications of the rate of retardation being somewhat greater at low than at comparatively high pressures; but, neglecting these indications, the above numbers give 1·043 second, as the average retardation in a six-inch or thirty-seconds fuse for each inch of mercurial pressure removed. This result agrees closely with that obtained by Quartermaster Mitchell, if we except those fuses which he burnt at the greatest altitude, and in reference to which some error must obviously have crept in, either as regards the altitude of the station where the fuses were

* The three first fuses were burnt in the open air, but the arrangements for their ignition, and for determining the cessation of combustion, were the same as in the other determinations.

burnt, or the duration of their combustion. The latter source of error is perhaps rendered less improbable from the fact that only two experiments were made at the greatest altitude, whilst six were performed at two, and four at the third of the remaining stations. The following table shows Mr. Mitchell's results uniformly with those in the last table. The fuses which he employed being fifteen-seconds or three-inch ones, I have doubled their times of combustion, in order to bring them into comparison with the six-inch fuses which were used in my experiments:—

Pressure in inches of mercury.	Average Time of Combustion of 6-inch fuse.	Increase of Time of Combustion over last Observation.	Reduction of Pressure corresponding to increase of time.	Increase of Time for each diminution of one inch pressure.
29·61	28·50 seconds	. .	. .	. .
26·75	31·56 ,,	3·06 seconds	2·86 inches	1·070 seconds
23·95	34·20 ,,	2·64 ,,	2·80 ,,	·943 ,,
22·98	36·25 ,,	2·05 ,,	·97 ,,	2·113 ,,

Here, omitting the last determination as abnormal, we have the average retardation in the combustion of a six-inch fuse, for each diminution of one-inch mercurial pressure, equal to 1·007 second, which coincides almost exactly with the number (1·043) deduced from my own experiments.

The results of both series of observations may therefore be embodied in the following law. *The increments in time are proportional to the decrements of pressure.*

For all practical purposes the following rule may be adopted. *Each diminution of one inch of barometrical pressure causes a retardation of one second in a six-inch or thirty-seconds fuse. Or, each diminution of atmospheric pressure to the extent of one mercurial inch increases the time of burning by one-thirtieth.*

This retardation in the burning of time-fuses by the reduction of atmospheric pressure will probably merit the attention of artillery officers. At present these fuses are carefully prepared so as to burn, at Woolwich, a certain number of seconds; and the perfection with which this is attained is highly remarkable; but such time of combustion at the sea-level is no longer maintained when the fuses are used in more elevated localities. Even the ordinary fluctuations of the barometer in our latitude must render the time of combustion of these fuses liable to a variation of about ten per cent. Thus, a fuse driven to burn 30 seconds when the barometer stands at 31 inches, would burn 33 seconds if the mercurial column fell to 28 inches. The height to which a shell attains in its flight must also exert an appreciable influence upon the burning of its time-fuse: to a still greater extent however must the time of combustion be affected by the position of the fuse during the flight of the shell; if it precede the shell, the time of burning must obviously be considerably shorter than if it follow in the comparatively vacuous space behind the shell.

With regard to the cause of this retardation, it must be borne in mind that the combustible matter of the fuse never comes into contact with at-

mospheric air until it has left the fuse-case; hence the diminished amount of oxygen in rare atmospheres can have no influence whatever in producing a slower combustion. The composition contains within itself the oxygen necessary for combustion; and a certain degree of heat only is therefore necessary to bring about chemical combination. If this heat were applied simultaneously to every part of the fuse, the whole would burn almost instantaneously. This sometimes approximately occurs, when, by the expansion of the wooden case into which the composition is rammed, a slight space is formed between the latter and the former, thus allowing the deflagration to propagate itself between the case and the composition. Under such circumstances the fuse burns with explosive rapidity, and probably the occasional bursting of shells before, or immediately after leaving the gun may be due, in some cases, to this cause. Under normal circumstances, however, the fuse burns only at a disc perpendicular to its axis, and the time occupied in its deflagration necessarily depends upon the rapidity with which each successive layer of composition is heated to the temperature at which chemical combination takes place. This heat necessary to deflagration is evidently derived from the products of the combustion of the immediately preceding layer of composition, and the amount of heat thus communicated to the next unburnt layer must depend in a great measure upon the number of particles of these heated products which come into contact with that layer. Now, as a large proportion of these products is gaseous, it follows, that if the pressure of the surrounding medium be reduced, the number of ignited gaseous particles, in contact, at any one moment, with the still unignited disc of composition, will also be diminished. Hence the slower rate of deflagration in rarefied air.

IRON SHIPS AND IRON PLATES,

WITH REFERENCE TO VIEWS RECENTLY ADVANCED IN THE THEATRE OF THE INSTITUTION.

By Captain E. G. Fishbourne, R.N. C.B.

I must beg the indulgence of this meeting, as, owing to the limited time given, my paper is not as carefully drawn as I could have wished, or the subject deserves. My friend Captain Halsted having placed the subject in an incorrect form before the public, it became desirable that more light should be thrown upon it, and that the two papers should be published together.

In making more particular mention of his papers, my old shipmate will not think me actuated by any personal feeling hostile to him, as he expresses himself open to every shot that any body is pleased to fire at him.

I understand Captain Halsted to state in his lectures that this country is at a considerable disadvantage as respects our neighbour, because iron ships with plated sides have not been added to our navy. In this I believe Captain Halsted to be greatly in error; that it would not have been for the interest of this country to have initiated the construction of ships of war solely of iron; and that the advantages likely to be obtained by building iron rather than wooden ships are much over-estimated by him.

The subject is no doubt complicated, the more so from the difficulty arising from the paucity of experiments and the varied estimates of them; but Captain Halsted's mind has been so occupied in the contemplation of one "side of the shield," that he has sometimes forgotten his subject, sometimes the bearing of the facts he records; and, when the latter fails him, he has indulged in unwarrantable surmises, and has suggested inferences at variance with generally acknowledged analogies.

It were difficult and certainly improper to have omitted the name of General Sir Howard Douglas from any history of iron in connection with ships of war; but, as his testimony was adverse, Captain Halsted undertakes to show that that officer's judgment was unduly biassed, in which I think he fails, as the sequel will prove; thus building on an alleged confusion of dates in statements made by Sir Howard, he questions that officer's knowledge, at so early a date as 1841, of what Captain Halsted terms "anomalies first discovered" during experiments made at a subsequent date, viz. 1846, and on which, as was alleged, but based on similar facts, he had formed an opinion adverse to iron ships for war purposes. Captain Halsted is wrong in his facts and doubtless in his surmise. Sir Howard mentions, in the third edition of his work on Naval Gunnery, page 163, experiments

which were made in France in 1833-4, which gave results similar to those obtained from the experiments of 1846 in England; therefore neither that officer nor the Government had to wait "the anomalies" of 1846 before they formed the judgment, the ground for which, at so early a date, Captain Halsted had supposed himself to have shown did not exist.

Similar injustice is done when Captain Halsted infers that, as no mention appears in the public records of the operations in the "Parana," examined by him, of men killed or wounded by iron splinters, that therefore none were so; why, as well infer that the parasol plug said by Captain Halsted to have been used was not used, because no mention of its use is made in the same records? With more impartiality, Sir Howard gives facts that make against his general argument, while Captain Halsted accredits only those that make for his views. That there were "extraordinary reports" as to the danger from splinters of iron, however much Captain Halsted may affect to ignore them, is clear from the extracts which he gives from the evidence of Captain Charlewood, who was not speaking of mere rumours, but of authentic reports, the existence and reality of which were confirmed by Captain Sullivan, who was present and took so distinguished a part in the "Parana," where the vessels alluded to were engaged.

At page 186 we find conclusions adverse to iron, questioned on the plea that experiments made on a target rather than on the side of the "Trusty" were unfair to iron, for that the latter was "fifty-six times heavier than the former, and, as a consequence, was at each shot driven bodily back to an extent which amounted to several feet at the end of the experiment." Captain Heath clearly showed that just in proportion as the target recoiled was the blow on the iron rendered less severe, and its chance of being broken reduced; consequently, the proof as to the fairness of the experiment is the reverse of that desired by Captain Halsted, and unduly favourable to iron; and, though thus instructed by Captain Heath, as also by Mr. Samuda, he reproduces the charge of unfairness in a subsequent Lecture, supported by an illustration drawn from Nasmyth's hammer, which he showed by an elaborate drawing (see Journal, No. XVII. plate 4) as placed on piles and otherwise made unyielding; but this attempt, where made, was for the purpose of ensuring the full effect of the hammer upon the iron placed on the anvil, and therefore the more heavy or solid the "Trusty" or the target, the greater would have been the blow inflicted on any iron placed against her side, which is the opposite to Captain Halsted's conclusions.

We are informed that the treatment of iron was again unfair when it was placed on the sides of octogenarian ships, by which is implied that they were rotten from age; Captain Halsted is fully aware that there is no warrant for such an inference, as the age of a ship by no means implies that her sides formed any portion of the original construction; and the "Trafalgar" table in this Institution, taken from an older ship than any that had been experimented on, viz. the "Victory," will show that there is sound timber in very old ships: indeed, if the latitude taken by Captain Halsted in drawing inferences were admitted, there would be no difficulty in arriving at any conclusions he might please, whatever might be the facts.

The fact is, two ideas have been confounded that ought to be kept sepa-

rate, viz. the force of impact, and its effect, and the degree of protection afforded by the addition of a wood backing.

Captain Halsted questions the English experiments, because the conclusions drawn from them make the opposite way to his wishes; but does not attempt to explain the fact that the French came to the same conclusions from their experiments, though they were much more reluctant to come to this conclusion, as they had expended large sums in erecting factories for the construction of iron ships in their dockyards. General du Bourg sums up their conclusions in the following sentence: "Of all steam-vessels that can be constructed, those made of iron are the most improper for war."

Speaking broadly, in the Lectures under review, the question is put as Iron *versus* Wood, as if a combination that embraced the advantages of each, while limiting their respective disadvantages, were impossible; the burthen of evidence being to the effect, that each has a province in which the other imperfectly competes, and, as a whole, used in combination, they are most usefully employed.

Some of the points of superiority claimed for iron may, under limitations, be granted; but all cannot, unless we suppose iron an exception to the general law of compensation, viz. that advantages of one kind are on the whole nearly counterbalanced by disadvantages of another kind. Captain Halsted claims for such ships "greater lightness with equal strength," and "a maximum of strength with a minimum of material," though he admits the relative strength of wood and iron to be in the ratio of their respective specific gravities; nor can it be supposed that the greater strength which he refers to, is that possessed by iron under peculiar circumstances, the result of a greater facility in the combination of parts in a ship, for he also claims "greater facility of imparting strength of material to every subordinate portion." Some of the statements advanced by Captain Halsted in support of his views were candidly admitted by Mr. Samuda, one of the most distinguished of the ship-builders in iron, to be but opinions, as it was a fact that iron ships had been found to be weak; and that it was quite right that ships constructed of iron should not have been hastily adopted, nor till their defects had been corrected, which he believed had been so to a great extent.

Amongst these statements we find that the "Nemesis" was saved by her watertight bulkheads, without that, which should have been added, as more than probably was the fact, that she was saved from a danger originating from the weakness of her bottom, one common to all iron ships, the "Warrior" not excepted, though in her the danger is very much lessened by the introduction into her construction of what may be termed an inner bottom. The defect alluded to was pointed out by Captain Sullivan, and is one that can be remedied, if entirely so, only at the expense of two of the qualities claimed for iron ships—economy and lightness. There is no filling or support given in the bottoms of iron ships to the sheathing between the ribs; whereas in wooden ships, between the ribs, it is filled in solid, and caulked—near the keel the timber is three times the thickness of the sheathing, and nearly double, as far up as 16 feet from the keel, in a three-decked ship.

Captain Halsted, while endeavouring to enforce his views as to the great strength of iron ships, offers illustrations that are scarcely pertinent, as

ships are seldom, and never ought to be, subjected to the description of strain referred to by him. The "Great Britain" is shown to have survived a winter's residence in Dundrum Bay, we are left to infer, because of her great strength; the fact being, that she survived because she was surrounded by yielding faggots that broke the sea ere it reached her, and we are left without proof that a wooden ship with her elastic properties would not have survived also if in a dock of faggots.

The rigidity claimed for the "Great Eastern" while in her cradle is interesting, but it is rather an element of destruction than of practical strength—thus the "Nemesis," when going round the Cape in 1841, as her stern lifted, her sides (and they wanting the elasticity which had they been of wood, they would have possessed) bent, and each sea bent them still more till finally they cracked, to avoid fatal consequences from which she put into Mozambique.

Captain Sullivan claimed for wood over iron ships greater immunity from serious danger on getting on shore, which was not overturned by the statement, that if the iron "Birkenhead" was lost, so also was the wooden "Thunderbolt;" since the former broke up so suddenly that 400 hands were lost, while from the latter none were lost, she having survived, while steaming several miles, to select a suitable place on which to beach her: had the "Birkenhead" been forced off the rocks a much greater number of lives would have been sacrificed. Captain Sullivan gave an apt illustration, in a recent fact of the war in the Baltic, of the value of the greater security of wooden bottoms under such circumstances. I may add one taken from the history of an ancestor of Captain Halsted, which struck me, when I heard it many years since, as a proof of that genius and courage which subsequently made him so renowned. Lord Exmouth, when in command of a ship of the line cruizing on the coast of France, standing in for the land in the grey of the morning, the ship bumped over a ledge of rocks, on which Captain Pellew jumped out of bed and ran out of his cabin; a glance round, showed him that he was embayed, that his only chance was to watch the rise of the sea and jump her back again over the same rocks, and that no time was to be lost in effecting this, which he did without material damage to the ship, which it may be confidently asserted would not have been the case with a ship with an iron bottom as at present constructed. This defect it may be said, not without truth, is not sufficient to condemn iron altogether, yet it is a full justification of those who do not adopt it altogether to the exclusion of wood. In proof of the weakness of iron ships may be quoted some reports collected by Mr. Taylerson, himself an iron-ship builder, together with some remarks of his own.

Thus in speaking of so-called watertight bulkheads and on which so much stress has been laid, he says, "Although bulkheads under the present mode of construction are said to be watertight, they are not so in reality, because, were the angle-iron frames from which they spring, so closely riveted as would be necessary under the pressure of a column of water, say 18 feet, the frame to which the bulkhead is secured would be nearly cut in two by the displacement of iron to form the rivet-holes."

The losses of the following ships fully bear out what has been said as to the weakness of iron ships. The "Eva" was struck by a heavy sea, a loud report alarmed the passengers, and investigation proved that her keel

was broken in the centre. The "Birkenhead" broke in two halves, 400 of the passengers perished; the "Yorkshireman" broke in two; the "Duchess of Sutherland" broke in two; the "Tayleur" shared the same fate, and 450 souls perished; the "Prince" broke in two parts; the "Transit" split. Somewhat similar disasters occurred to the "Ida," the "Loire," the "Pacific," the "City of Glasgow," the "Ada," the "Brigand," &c.

And here I cannot allow a remark of Mr. Samuda to pass without comment; it was to the effect that Lloyd's, who were admittedly good judges, charged 7 per cent. insurance on wooden ships, while the Peninsular and Oriental Steam Company insured their own ships at a cost of only 2 per cent.; this arises not from their ships being all built of iron, which is not so, but from their being better commanded and better found than ships generally are, and from their making short voyages, and running from dock to dock, when any defect is immediately remedied.

We have been treated inconsiderately, for Captain Halsted's views of strength, with a graphic description of the weakness of the iron "Ruby;" and yet this weakness does not appear to have been the result of age, but rather of a disease not uncommon in iron ships. Thus the "Mermaid" man-of-war nearly fell to pieces at sea near the coast of Africa, and but for more than ordinary fortune would have drowned her crew. She was sold, together with her engines, for 100*l*. Many of the holes in her bottom were stopped with corks.

Commander Burton was ordered to have the bottom of the vessel he commanded frequently examined, lest some morning he should find her bottom eaten through, and himself and crew making a sudden exit; and the captain of the "Grappler" put his foot through her bottom—not, I apprehend, because of the great strength of every subordinate portion.

Captain Halsted gives, as a proof of the weakness of wood vessels, the fact, that a company built a fleet of first-class wooden screw ships to perform regular transatlantic voyages, adding that "they were foreigners, for that Englishmen would not have been so foolish." He does not say, but suggests, "as to build wood ships;" implying that the failure of the company arose from this; whereas the failure, if attributable to the ships, was not that they were built of wood, but that they had adopted screws instead of paddles for such a service. This is another proof of what my old shipmate is unwilling to admit—that paddle-wheels have a province in which screws cannot compete with them.

The great defect in iron bottoms, from their becoming so foul, is admitted in these Lectures; but is by no means sufficiently dwelt on, since it involves the whole question of economy and of general utility.

Captain Burton mentions that when he left England in an iron steamer he could obtain 11 knots from her, from which she gradually fell off till he could with difficulty obtain 8 knots; though otherwise, under more favourable circumstances for speed, the difference of indicator horse-power, and consequent expense, may be represented approximately at being as the cubes of 11 and 8 respectively, or as 500 to 1,300. A contrast of the performances of the Queen's yacht with those of the "Leinster," one of the new steamboats on the mail packet service, will bring this disparity out though iron, in this case, is under the most favourable circumstances, viz.

running from dock to dock short voyages, without time being given for the bottom to become foul.

"Leinster:" length, 400 feet; indicator horse-power, 4,300; area of mid-ship section, 350 feet; speed, 18 knots.

"Victoria and Albert:" length, 350 feet; indicator horse-power, 2,980; area of midship section, 400 feet; speed, 16·97 knots.

It will be observed from the above statement that the speed of the "Leinster" is a little more than that of the yacht, but that the length of the former is greater, the area of mid-section less, and the indicator horse-power very much greater. Employing these elements in a common formula, we discover that the speed of the "Leinster" ought to have been much greater for this expenditure of power; and, by a quantity represented by about 1,000 indicator horse-power, the expense of the additional horse-power and of the additional running cost must stand as a charge against iron; but if, as is supposed by many, that a maximum speed is indispensable, and if we find enormous sums are expended to arrive at such, it is difficult sufficiently to estimate the defect thus entailed by an iron bottom. The inevitable conclusion from the above is, that a ship with a bottom of iron in the ordinary condition, as at present, cannot, *cæteris paribus*, be as fast as a copper-bottomed wood ship.

So much for the question of iron ships. It is difficult to believe but that Captain Halsted assumes to have given sufficient of the history of experiments on iron to enable us to conclude not only in favour of its entire suitability for ships-of-war, but also of its impenetrability as armour, or by introducing the letter on the subject of an alleged shot-proof corvette, that he does not claim for the writer to have been the originator of the "Warrior," "Black Prince," and their congeners; yet is each very far from being the fact; he commences the history from 1846, which falls in well enough with his fancies, but falls out most materially with all the facts of the case.

In any history of iron covering, it is due to Mr. John Pode Drake to mention that as early as 1830 he proposed to introduce 6-inch slabs of iron into the construction of shore batteries; and in 1835, 4½ and 5-inch plates for the protection of the engines of steam ships; and in 1841, iron-clad blockships, the latter in official letters addressed to the Admiralty. These propositions were more or less public, and are likely to have originated the subsequent propositions made in England; the credit of priority is due to that gentleman, than whom a more prolific and ingenious deviser is seldom to be met; his misfortune has been to have been so far in advance of his age. His propositions were rejected before the period at which Captain Halsted commences his history, and for the rejection I think there was high national policy.

The French experiments in 1834 and 1835 elicited facts strongly adverse to iron for ships-of-war; and though Colonel Paixhans proposed to build ships and render them shell-proof by their being *cuirassés en fer*, yet making ships shot-proof was deemed impracticable by the French Government equally with our own. Much of the matter given as evidence in favour of iron scarcely deserves to be accepted as opinions, there being so little to warrant the formation of any; and it is a matter of wonder that such should have been given in the face of specific facts on the points in

question—it is stated that "a shot struck the 'Nemesis' in a slanting direction, merely indenting the iron, glancing off without penetrating."

Again, a shot struck the counter of the "Guadaloupe," indented the iron, and glanced off; it is added, "had the vessel been constructed of wood, this shot, I think, would have entered." The answer to this is, that a shot struck the "Hermes," not obliquely, but plump, near the galley, attracting the attention of a soft young midshipman, who ran to see where it entered; a sharp young fellow leant into the galley and pulled out and handed to the youngster what he thought was the identical shot, with which he ran to me.

Ah! my friend will say, there is the evil of wood; the sequel affords more reason than any afforded by the previously stated facts for the opposite conclusions drawn from them, to infer that, if the side had been of iron, such as that in the side of the "Nemesis" or "Guadaloupe," it would have been penetrated; in the case just stated the supposed shot was but a yam that had been roasting in the ashes in the galley, the veritable shot having spent its force before it reached, and sunk without leaving a record of its blow.

These loose statements relative to shot glancing, are in direct opposition to the result of experiments with unspent shot given by Captain Halsted himself, by Sir H. Douglas, and by Captain Scott, which are to the effect that shot do not glance, but rather plough up the side, and that therefore the presumption is rather that one inch of iron would be cut through or torn when much of its equivalent eight inches of wood would remain intact.

The discredit thrown upon the English experiments, which resulted in the condemnation of iron, is not warranted by any fact given by Captain Halsted himself, and no one can have heard Mr. Fairbairn's candid statement, and not feel satisfied that Captain Halsted's views on that subject are not just.

Mr. Fairbairn, than whom, as an eminent iron-ship builder and experimenter in iron, there are very few more capable of giving an opinion on such a subject, or of suggesting suitable experiments, was actually present, and suggested some of the experiments that were made, and states, that, after introducing sawdust and other materials between plates of iron, for the purpose of intercepting some of the numerous splinters into which both the plates and shot were broken, without success, he came to the conclusion arrived at by the authorities, that iron, in the shape then experimented on—for, he added, he was not aware that any one had suggested thick plates of iron—was not suited for the material of ships-of-war.

There can be no reasonable doubt but that iron is better suited for resisting shot or shell than wood; but the question that vessels of war should be constructed solely of it, cannot be decided upon, on such limited grounds; and, though it had been established, as it has not, that practically the plates on the "Trusty" were impenetrable, still there are many other considerations to be weighed before it could be affirmed with justice that our Government had been to blame for not having built a fleet of ships clad with iron plates of 4 or 5 inches in thickness.

Much has been built up upon the fact that cast-iron shot broke up on striking plates only $\frac{5}{8}$ of an inch in thickness; this now proves to have been exceptional. Captain Scott stated that cast-iron 68lb. shot had

passed unbroken through plates 3 inches in thickness. A moment's thought would suggest that the thickness passed through, would depend upon the quality of the iron plate, and upon the degree of tension in which the shot was left by annealing; want of thought has in this, as it often has before, led to a hasty generalization, and red tape possibly has saved us from the evil of rash judgments.

The fact that ordinary cast-iron shot do not break up on striking, but pass through 3-inch plates broken or unbroken, establishes that shells can be constructed that shall pass through such or greater thicknesses of iron, and puts still further off the prospect of obtaining iron-clothed ships altogether suitable for the general purposes of war. Overlooking the effect of splinters, Captain Halsted, in his diagrams of the "Warrior" and "Gloire" [see Journal, No. XVII. Plate 3], places the side of the latter oblique to the fire of her opponent, supposing that this position would be good, whereas, in proportion as the shot of the former did not penetrate the armour-plates of the latter, they would cut off her men, or upset or injure her guns.

It will be remembered that the ships at Sevastopol were two hours under fire, showing that wooden ships are not so vulnerable as may be thought. Experiments made by Mr. Samuda showed that red-hot shot and molten metal, each far more hot than they could be when fired from ships' guns, failed to ignite wood; these facts, taken in connexion with the greater handiness and greater speed which give advantage in manœuvring, and her much larger number of guns, give the balance of advantage to the wood ship at short distances, justifying the opinion of the officer cited by Captain Halsted, who said, after having witnessed the experiments at Portsmouth, that the injury to material and life in a ship of iron, resulting from the fire of 8 or 10 inch hollow shot, would be greater than in one of wood. A somewhat refined line is drawn between shells bursting inside and outside; accepting the latter as the advantage derived by iron plates, we need from Captain Halsted an explanation as to how he would provide for loading and sponging his guns with showers of fragments sweeping along the iron-clad sides and into the ports, by which also the most effective defence and offence—viz. accurate and rapid fire—are rendered impossible. The Duke of Somerset mentions that 700 fragments were counted after some experiments, which it may be safely affirmed to be greater than from the bursting of any shell; and, as to injury or death, the choice of weapon by which it is inflicted is small comfort. It has been overlooked in these lectures that there are two sides to every question—we may now profitably look a little at the side previously unnoticed.

Though the measure of impenetrability arrived at by the use of iron were not at the expense of great weight and of grave cost, yet there are other objections that lead us to question its value. Captain Halsted mentions that, on one occasion during the experiments on iron plates, a sentry was struck by a splinter while distant 200 yards from the target, and obliquely *in front;* this, and the accidents which occurred at Kinburn, serve to show that there is not the immunity from danger claimed for the iron-clothed ships, for in proportion as the armour resists, do the shot break up, and thus splinters enter the ports in greater quantities, justifying the conclusion that the history of the world is made up of compensations.

These fragments, both of shot and shell, injure the men who are collected at the ports; they also may injure or upset some of the guns; whereas, had such as struck between the ports been allowed to pass, less injury would have been sustained both by men and material. In the "Devastation" French floating battery ten men were killed, and seventeen out of twenty-two casualties to the *personnel* in the French ships occurred on board the three iron-clad ships.

There are two or three fallacies pervading the arguments in these Lectures, one of which would be fatal—how much more when several are involved! At page 185 the case is said to be "placed in its true common-sense view." How that can be, I am at a loss to understand, when the view given is contrary to possibility; thus, two ships are supposed "perfectly equal in size" and equal in other respects, "except that one possesses the additional protection to her sides of an iron armour four inches thick." Surely we need to have it explained, how of two ships of equal size, the one carrying several hundred tons of iron on her sides, that one can possess equal qualities with the other; how she can steam as fast; how she can carry her ports as high; how she can steer as well; how she can possess even approximately as good sea-going properties; how she can carry as many guns; or how her properties, &c. will admit of equal rapidity and "precision" of fire;—it is simply impossible. The common-sense view would be a mercantile one: Given an iron-clad ship carrying, say, thirty guns, costing 400,000*l.*, how many wooden ships, possessing higher seagoing qualities and more speed, and mounting each fifty guns of equal or larger calibre, could be built for the same money? and, lastly, which of these, the one iron-clad ship with 30 guns, or the four or five with 200 guns opposed to her, are likely to be first destroyed or compelled to abandon the contest? If Captain Halsted is not more impenetrable than the iron, he will declare, anything he has written to the contrary, for the many over the one. Be that as it may, there can be but one idea as to which were of the greater value for the protection of our trade, our colonies, or our homesteads. There never will be wanting men who will, with any two of these ships, undertake to "bell the cat," and leave the other two or three to defend our own or attack the enemies' coasts or commerce.

Another fallacy is, that the powers of attack are assumed to be exhausted, while they are as yet untried; the guns which have been employed are those which were constructed for breaching the sides of wooden ships. Armour necessitates, for complete success against it, a larger description of ordnance, and there is no difficulty in constructing such as will breach any side that can be applied to a useful ship, as guns may be built that shall carry shot double the weight of any as yet tried against plates, and the velocity of striking at or within 1,000 yards can be greatly increased by the use of smooth-bore guns, by which the force of impact may be increased four or five fold; and I may add, that increased velocity is the prime element in accuracy of fire in a ship's gun, owing to the fact that one or both ships engaging may be in motion in one or more directions; therefore the sooner the shot ranges its distance, the less is the chance that the object will have passed out of the line of fire. To resist such missiles, 10-inch plates would not suffice, and yet the idea of a ship carrying even 8-inch plates is preposterous, for the "Warrior" has but

4½ plates over two-thirds of her length, and yet she is of 6,000 tons burthen. There are but two or three ports in England deep enough to receive her, and very few docks; added to which, such ships must be unmanageable in narrow waters and in seaways, where the wooden ships will be still serviceable. Greater size and weight would have aggravated all these evils.

I said that there were high national considerations that fully justify each Government in not having at an earlier period embarked in building iron-clad ships, and Captain Halsted abundantly establishes this view when he dwells upon the moral injury that will be done to our sailors by putting them to skulk behind shields, &c.; but his argument goes further, for it makes also against the use of armour-plates. I thoroughly concur in the view that all that has been said of our danger from the iron ships of our neighbour as tending to create a moral courage in his men, and so far, if possible, to depress that in our own men, originates or increases the danger said to exist. To my mind it is unintelligible how this country could in any wise have been more safe, or its interests more advanced, by our having built a number of bad ships simply that they might have carried iron armour; and, as for the experience obtained by our neighbour from the "Gloire," I fully believe it to be of a negative kind, and is but a small set-off against his bill of costs. I have no doubt but that any one of our large ships would give as good an account of her as they have ever given of other ships; our successes have ever been independent of superiority in the material, and I doubt not will continue to be so, though our ships should again be inferior in some points. I say this, not to justify any inferiority, but to deprecate the indulgence in misgivings. Give our mechanicians latitude for the construction of suitable guns, and there will be, if possible, less reason for any. I have no sympathy with that feeling which implies that we have incurred losses of any kind, and still less danger, by not having embarked in the construction of an iron fleet; to have done so would have been to have proclaimed either that we were actuated by unworthy fears, or that we entertained purposes of unjust aggression. It would have been to have changed the venue from Paris to London, together with the persons under trial before God and the world as disturbers of its peace. Alarms are paralysing, and lead to undignified haste in the adoption of radical changes, both unworthy a great nation like this, which should sit calm in a sense of its strength. "Thrice is he armed whose cause is just: God will defend the right."

The CHAIRMAN.—We are very much indebted to Captain Fishbourne for having brought forward his view of the question, in contrast with other views that we have previously heard. This Lecture shows that there is still matter for controversy. There seem to be many points on which naval officers of the greatest experience, and builders, differ; but if, in this discussion about iron and wood, we could make out that there were any points upon which all were agreed, we should then have gained something for the service.

Mr. SAMUDA.—I am sure, after listening to so able a paper as that which Captain Fishbourne has just read, he will be very glad to be put right: I think a want of knowledge of some of the points has led him to a wrong conclusion. With regard to the resistance of wood and iron in the case of the "Victoria and Albert," as against the "Leinster," I take the statements given to be as nearly as possible the correct results of the speeds obtained by the two ships; and I will go further and state, that if the ultimate speed obtainable with the power stated as belonging to the "Leinster" was only eighteen

knots, as against seventeen knots obtained in the "Victoria and Albert," that there would be a justification for coming to the conclusion that the resistance was due to the material of which the ship is formed. Such is not the case. The resistance in the case of the "Leinster," and the diminished mechanical result in her case, is owing entirely to the dip of the wheel being very much greater than it is in the "Victoria and Albert," and very much too great for the due performance of its work. Without going into details, I may mention that the "Victoria and Albert" suffered from exactly the same defect, and with exactly the same result. The wheel was altered, and the performance was improved. I have tried to persuade Messrs. Ravenhill, the makers of the excellent engines in the "Leinster," that a similar beneficial result would take place from their doing exactly the same to her wheel as Mr. Penn did with so much effect to that of the "Victoria and Albert." When the "Victoria and Albert" was first launched and tried, her speed instead of being seventeen knots was a little under sixteen. A foot was taken off the wheel, and the result was that the speed improved by upwards of a knot. The result would be the same in the "Leinster" if the same thing were done to her. But that I may not lead you astray, by merely quoting the probability of what would take place if that were done, I will give you another instance which will at once remove from you all impression that any difference exists in the friction from iron and wooden vessels, coppered. The "Tamar" is a wooden vessel. She received engines of 400 horse-power from the manufactory of Mr. Penn. She is a vessel that was built for the Royal Mail Steam Company. I built for the Peninsular Company a vessel called the "Messilia," with as nearly as possible the same dimensions and size as the "Tamar," and having engines identically the same in every possible respect. The lines of the two vessels were drawn by the same hand (viz. that of Mr. Oliver Laing, of Chatham dockyard), the very best naval architect, in my opinion, that exists for giving lines to ships. They are very similar. In all respects the engines are identical; but the "Messilia," when she was tried, had considerable more displacement, by having more weight on board, and having a midship section of 455 feet to drive, against 390 feet in the "Tamar." The speeds of the two vessels were within a tenth of a knot of one another, therefore they entirely reverse the conditions which Captain Fishbourne has supposed to exist between wooden and iron ships. Since that time those vessels have been at sea, each of them performing their relative services for the companies for which they were engaged for three or four years, and one with all the disadvantages of the ordinary fouling which takes place; the result has been that the performance of the "Messilia" has been three-quarters of a knot greater than the performance of the "Tamar." This, therefore, at least shows that there is no difference as against iron compared with wood. If I were to take up the time of the meeting by showing what the result of an increased dip of the wheel would be, it would be palpable to you at once that this result before alluded to would be at once attained by the reduction of the float; but I have sufficiently, I think, convinced you of that by telling you a fact which you can all ascertain by application to the right parties. I know that Captain Fishbourne got his speeds from Mr. Watts at the Admiralty, for I happened to be at the Admiralty when his letter came in, and I checked Mr. Watts in the statements he made in reply. I was therefore not unprepared to hear a comparison drawn unfavourable to the "Leinster," arising only from a want of knowledge of the facts which I have given to you. If you make application to Mr. Watts again, you will find that before one foot was cut off from the wheels of the "Victoria and Albert," instead of her speed being seventeen knots an hour it was then sixteen. Therefore, you see how very careful persons desirous of arriving at truth should be to ascertain facts before they draw conclusions.

As I do not appear to have quite convinced Captain Fishbourne, I may refer to one more fact, to show him that iron ships are not so insignificant in their performance as compared with wood, as he would lead us to suppose. I told you I built for the Peninsular Company the "Messilia." She is 1,900 tons burden, and in her were placed those engines of 400 horse-power by Penn. The engines which I put into that vessel at the time did not even have the advantage of being new engines. They were engines seven or eight years old. I took them out of a wooden vessel, belonging to the same Company, called the "Vectis," and this wooden vessel, instead of being 1,900 tons, was only 900 tons burden. The Company applied to me to advise them what they should do with this vessel. I said, "Let me take these 400 horse-power engines out of that vessel, and build a vessel of 1,900 tons for them, and I will give you the same speed in the 1,900 tons vessel that you are now getting in that of 900 tons, and even give you a considerably greater speed than that in a sea in bad weather. This was done. These engines had been working in the "Vectis" for some five or six years. The greatest speed they got upon trial in smooth water was $14\frac{2}{10}$

knots per hour. The speed which we got on trial in the 1,900 tons vessel was exactly the same. The speed which the smaller vessel had been getting at sea was between nine and ten knots, while that which we are getting at sea is between ten and eleven knots. After that I do not think any one can say there is any inferiority in the material. In fact there is no inferiority in the material. That there is a very great loss of speed when vessels foul there can be no doubt. But I think a candid treatment of the subject brings you to this conclusion, that, if upon the balance of advantages it is necessary and desirable you should use iron, it becomes necessary and desirable that you should take such means of meeting the defects of the system, such as fouling, as will enable you to make those vessels work efficiently. There is no doubt that, when you introduce a new subject, such as building vessels of iron, you cannot at once make all the preparations at the different ports and stations where the vessels are to be stationed, to enable you to get rid of the serious defect of fouling. But there is no difficulty in getting rid of it. It is a mere question of putting slips and docks as tide-ways and places will admit of. It is only a thing which will be difficult to do at the present moment, because of the want of means; but, if you look forward to ten years, and find the advantages to be gained from iron ships are only limited by the question of fouling, you will find that there will be no greater difficulty in selecting the places and obtaining means of cleaning the bottoms of iron vessels than you have at the present time in finding places and means to re-copper the bottoms of wooden ships. I go one step further in regard to what has been said of wooden ships and iron ships, as to the respective thickness of their bottoms. I think a great deal of stress ought to be attached to this circumstance, that though a wooden ship is a perfectly beautiful machine for the purpose of being used as a sailing ship, or even for the purpose of being used as a paddle ship, where the power to propel it is placed in the centre of the ship, and where no great weight and no great strain has to pass through the ends, yet, when you come to that which we have arrived at in the present day—a question of the balance of advantages, which has resolved itself into the necessity of using the screw—then the wooden ship gets into the great difficulty of not having a sufficient amount of strength at the ends, those ends having to meet the requirements of the high speed which is called for in the present day. The necessity to use iron ships has arisen, if you want to get out of these ships a high rate of speed, which means, in other words, a great amount of power passing through the stern. Everybody knows that iron can be rendered a homogeneous mass by the mode in which it is put together. If iron is judiciously put together, every plate in the ship can be rendered equally strong as would have been the result had each side of the ship been built of one entire plate of iron. Now, that is absolutely impossible in a wooden ship. In a wooden ship, the whole strength of the ship is derived from the fastenings; and their working in the ship tends on the one hand to increase the size of the holes in which they are placed, while, on the other hand, decay, rust, deterioration, and strain of all sorts, tend to decrease the size of the fastenings themselves; therefore, there is a continual working going on which results in a weakening of the ship. You cannot possibly make the substances homogeneous. You must depend upon the contact of the two materials; while the strength of the one in connection with the other, with all sorts of wear, &c. going on, will but tend to weaken the fabric, so as to render it less efficient every year that its age increases. When you come to deal with the matter of the artillery of the present day, though it is perfectly justifiable to refer to the experiments which are being made, and which may cause some doubt as to whether you can ever arrive at a thickness of iron on the sides of your ship that may render them wholly shot-proof and invulnerable against the improved artillery that can be made; yet I will just mention one or two circumstances to show how utterly impossible it would be to go on relying upon the old fabric of wooden vessels. At Sinope, though the Turks were taken at a disadvantage, this fact exists, and I have it from the first Russian authorities, that there was not one of those vessels of the Turks that stood more than three broadsides; most of them sunk with two broadsides, and some of them sunk with one broadside. Now, if you can by putting iron on the sides of your ship increase the resisting power of your ship from three to thirty broadsides, you would give time to the men on board to use their artillery, and probably to destroy their enemy's vessels. If you have a vessel that will only stand two or three broadsides, you would have a difficulty in getting men to go to sea in her; but if you put them in a vessel that could resist ten times that number of broadsides, no such difficulty would exist, because the chances in favour of that vessel would be increased tenfold. Therefore, however distasteful it may be to old notions, and to preconceived opinions, to get rid of the wooden walls of Old England, yet, go they must, so far as the protection of the men, and so far as the protection of the ship against the present improved artillery exists,

With that conviction, I think one cannot too much impress upon all persons, wherever one has an opportunity of speaking to them, the necessity of getting rid altogether of all these old-fashioned ideas; and, instead of seeking to point out the disadvantages in iron ships, which I admit are many in the present day, to apply the same amount of ingenuity and talent to meet and remove those imperfections.

Captain FISHBOURNE.—With regard to some of the remarks which Mr. Samuda has made, I thoroughly agree with Mr. Samuda that it is very important to sift out and examine all the elements that go to influence the result on any particular question; but I am sorry that he should have so widely departed from the principle he has himself laid down. Thus the vaguest kind of comparison is drawn between two ships; and from this, which in fact is no data, a definite conclusion is come to. In the same way it is suggested that if the dip of the "Leinster" wheel had been reduced, her disparity in speed would disappear, as if this could be done without altering any other element. Why, a necessary consequence of reducing the dip of the wheel would be that of allowing the engines to run up to a higher speed; and, if the boilers admit, there will be an increase of indicator horse-power, and an increase of speed from an increase of power, which was the case in the "Victoria and Albert," which also would be the case in the "Leinster" if her boilers admitted of it, and not from any improved mechanical advantage of a smaller wheel; but then this would have been shown in the formula which I have used in accordance with the principle stated by Mr. Samuda, but overlooked in his proposition to improve the speed of the "Leinster," when he omitted to estimate the cost of any such increase.

Mr. SAMUDA.—I assure you, you are mistaken; I will explain it to you if you wish.

Captain FISHBOURNE.—You surely will not tell me that, if the diameter of the wheel is reduced, the engines will not run up to a higher speed, and, if there is steam, give a higher indicator horse-power?

Mr. SAMUDA.—I assure you you are mistaken.

Captain FISHBOURNE.—With respect to the other two vessels mentioned, particulars from which to form a judgment are altogether wanting. Thus, as to form, the lines were simply drawn by the same hand. Two vessels might be taken whose lines were drawn by the late Mr. Fincham, and yet there might be scarcely any resemblance, and their speeds might vary as much, though they were intended for the same purposes, and have equal or nearly proportionate power. The horse-power mentioned is only nominal, which means nothing; and, while Mr. Samuda informs us that the engines of the faster vessel had been five or six years in use, yet he does not tell us the material point—that the boilers must have been new, and may have been of greatly increased dimensions. Therefore, nothing that he has said militates the least against the views advanced by me. I am sensible that iron has advantages, but I say that Captain Halsted has overestimated them. He claims cheapness. How this can consist with the expense of foul bottoms, and with the necessity admitted by Mr. Samuda for building works all over the world if this were possible, neither he nor Mr. Samuda has attempted to explain, and yet they cannot be omitted from any estimate of cost. Another item in cost is omitted—that involved in the increased size to carry iron coating, and the increased cost of this. Divisibility of force is necessary to defend the extended coasts and colonies of this country; but iron-coating necessitates the concentrating of tonnage equal to that of many vessels into one of 10,000 or 15,000 tons. The best defence is to attack; and, were we at war with France, did we attack him at a great many points with our thousands of steamers, we might safely let him do his worst with his few iron ships; and numbers of small vessels are a very far better security against the landing of an army than a few iron vessels of great dimensions. Mr. Samuda infers, that because the vessels at Sinope were sunk with two broadsides from ordinary guns, and as iron-clad ships will not be sunk with less than twenty or thirty broadsides from similar guns, that therefore the latter are more safe. This is altogether to to beg the question, for no one fancies otherwise than that suitable guns for breaching iron-sided ships will be supplied to those ships that will have to oppose them.

Captain HALSTED.—I wish to make one observation. Captain Fishbourne is perfectly right in supposing me to be impenetrable. I am so; yet I am very much obliged to him for his remarks. I believe they will be considered very happy illustrations when they come to be read with the Lectures upon which they are offered. But there is one mistake which Captain Fishbourne has made. It does not affect myself; but it affects Mr. Fairbairn. Now, the experiments in which Mr. Fairbairn was concerned were the experiments of 1845 and 1846, and which experiments were really and truly experiments. They were made with actual plates that were intended to be used, and were used, as plates of ships,

Therefore I have not by any means applied any derogatory epithet to those experiments. Mr. Fairbairn had nothing whatever to do with, and I am perfectly persuaded he is the very last man who would have countenanced, such experiments as those of the "Ruby," or any other of those which, for certain reasons of duty, I have designated to be nothing more than deceptive and spurious experiments.

Captain FISHBOURNE.—I would say, with respect to that, that Mr. Fairbairn stated here distinctly that he was thoroughly convinced by the experiments made in 1846, and the conclusions arrived at then were similar to the conclusions arrived at at Portsmouth. Captain Halsted admits that, whatever the experiments at Portsmouth were, those were satisfactory experiments which were made at Woolwich.

Captain HALSTED.—No; the reverse.

Captain FISHBOURNE.—I mean the Woolwich experiments that Mr. Fairbairn was connected with.

Captain HALSTED.—He was not connected with them; he was present.

Captain FISHBOURNE.—He suggested them.

Captain HALSTED.—No. He was present, but they were not suggested by him; they were suggested by Sir George Cockburn.

Captain FISHBOURNE.—Mr. Fairbairn said that he did suggest some of the experiments.

Captain HALSTED.—I do not mean to say that he did not open his mouth; but those were not the experiments which I designated by those epithets to which you have referred as being those at which Mr. Fairbairn was present.

Captain TYLER, R.E.—There is an officer here who says he was present at the experiments on the "Sirius" at Portsmouth. I do not know whether he would be kind enough to give us some account of them. I happened to be at Portsmouth myself last Thursday, when I went on board the "Sirius," and had the pleasure of inspecting the different plates, and the effect produced upon them by the shots fired at them. I went on board quite prepared to find that ports were useless and ships impenetrable; but I came away with a different conclusion. I saw plates and chains of all descriptions round the vessel. There were Mr. Beale's plates; there was Mr. Josiah Jones's angular target; there were two targets composed of nine chains, of about 6 inches thick, laid one upon another, and in each case the shot had gone through them; there were plates, with hills and valleys in them, which were all broken to pieces. I think that at the valleys they were about 4 inches thick, and at the hills about 6 inches thick. These were knocked all to pieces. There were other plates more or less broken. The angular plate of Mr. Jones had not been penetrated; but it had been considerably indented, and broken to pieces. But there seemed to be great difficulty in applying plates of that kind, inasmuch as the base of that target, which was about 7 feet high, was 15 feet. Now, 15 feet on each side of a vessel would take up 30 feet of its deck; and I think that in actual practice 30 feet in the width of the deck of a vessel could not be given up in order to allow of the application of plates in that form. In the case of Mr. Beale's smaller plate, the shot had gone through it, and split the plate in two, and carried a large piece out of the interior of the plate, and thrown it across the vessel. On looking inside the vessel, where the splinters from the plate had passed, I oberved that they radiated from the hole made in the plate over the deck. There were pieces sticking about in all directions—on the deck, and on the roof above. They stuck in the columns, and there were pieces on the opposite side. Evidently, from the appearance of the effect of that shot, no man could have lived anywhere near it when the penetration took place. This penetration had been obtained with guns which we have already in use—68-pounders—and I apprehend that we shall eventually get better penetration and greater power from guns that will be made in future. I do not believe that we have arrived at the limit of the guns which we are to employ, although there must be a limit to the weight of the plates which can be put on the sides of a vessel. The plates ought to be of a tough nature, so as not to splinter in this dreadful manner; otherwise, when they are penetrated by shot no one will be able to live near them. Of course, if we can make plates of a tough nature, and of such a thickness that they will resist shells—particularly Martin's shells—we shall do great good. The problem eventually, I believe, will be, to find out what thickness of plate will resist these shells, and be available for ship's sides, and to give up the idea of making plates of a thickness to resist shot. With regard to the question of fouling, one might infer, from what Mr. Samuda said, that iron ships did not foul at all.

Mr. SAMUDA.—No.

Captain TYLER.—Or almost so. I understood him to say that some iron ship had been going to sea for four years, and had been making more speed than a wooden one.

Mr. SAMUDA.—But she had been subject to the usual amount of cleaning.

Captain TYLER.—Just so; but you did not mention that; therefore I wanted to bring out the fact. Of course iron ships must have very great advantages, if we can obtain some means to prevent them from fouling. I believe no means have as yet been attained; but it must be, probably, either by placing copper upon them by means of electro-plating, or by putting a wooden case outside, and then putting copper on that. I will not detain the meeting longer, but I hope that Admiral Stopford, who was present at the Portsmouth experiments, will give us some account of them.

Admiral STOPFORD.—I saw the gun fired. The small plate that was broken was not Mr. Beale's, but a patent of Mr. Brown. A new sort of iron and additional work had been put into it, which had the effect of making it too brittle for the purpose. One of the firm was present, expecting great things from it, and he acknowledged that it was a great deal too brittle. The corrections of the *Times'* correspondent of the following day certainly gave what I should say was the correct state of the case.

Mr. SAMUDA.—I have seen the particulars of every shot fired at the "Sirius," and that plate of Mr. Beale's in many cases stood five shots within a distance of two feet of one another before it broke or tore away. That was the general character of the firing. I look upon the result as an extremely satisfactory one. The plate was only a 4½-inch plate. The only part of the experiment which I did not look upon as being so satisfactory was that in the first instance, wherever the shot impinged they only indented the plate to the extent of about two inches, and very slightly starred or cracked it; yet, strange to say, it dislodged a quantity of wood backing from behind the plate, and in many instances carried that wood-backing a considerable distance across the ship in the shape of splinters, though the plate had not been broken. It is a curious fact.

Captain HALSTED.—The "Sirius" is in her hundredth year.

Admiral STOPFORD.—But her timbers are very good.

Mr. SAMUDA.—I do not quote this by any means as an evidence that the iron plates were deficient. The *Times'* correspondent was entirely wrong in saying it was fired at with a 200-pounder Armstrong gun. It was fired at with a 68-pounder, with 16½ pounds of powder, from out of one of our 95-cwt. guns, at only 200 yards distance, a perfectly point-blank range. The gunboat being fixed, and the vessel being fixed, they were able to bring the target into so close a proximity to where the previous shot had hit, that, as I told you, five shots hit within a distance of two feet before the corner of Mr. Beale's plate was carried away. What I was going to say was, that the distance being very close, and the charge of powder very great, the plate was placed in the very worst position it could be to receive the shot; and then the blows had to be repeated many times in the same place before the men behind it could have been seriously damaged; indeed, I think, with all the destruction the plate has got, it still remains to afford a very considerable amount of protection to the side of that ship. When you come to take into consideration the way in which that plate was fired at, and compare it with the fact, that, of the Turkish frigates at Sinope, there was not one that stood more than three broadsides, and many of them went down with two, and some with one, you cannot help coming to the conclusion that the iron plates do afford a considerable protection to the ship's side.

Captain TYLER.—I understood many of the Turkish frigates were burnt.

Mr. SAMUDA.—No; they went down with the broadsides. I was told so by a Russian officer, who was in the engagement, I believe. The 68-pounder 95-cwt. gun is a more destructive weapon to bring against an iron ship than an Armstrong gun at short range.

Captain TYLER.—Do you know what happened to the shot the other day?

Admiral STOPFORD.—They dropped on the deck of the hulk on which Mr. Jones's plate was laid, and were all broken.

Captain TYLER.—All those that did not penetrate?

Admiral STOPFORD—There was one shot-hole made.

Captain BLAKELY.—It would seem there are two points of view from which the subject may be looked at. I have listened to what I think may be called the sailor's point of view; but, for myself, I cannot help looking at it from the artillerist's point of view. As I understand, sailors would like to have a very tough thick plate of iron. Looking at it as an assailant, in an artillerist's point of view, I should like to have nothing better than to fire at those very same thick plates. If perfectly tough and perfectly unsplinter-

able, so much the better, because, if the plates are made of the usual size of eight or ten tons weight, I think a shot could be made which, hitting one pretty fairly in the centre, would take in the whole side of the vessel which it covered—that is to say, it would take in the whole of the plate. There is no difficulty in making shot which would drive in that plate, whatever the size of it might be, bodily into the vessel; it is a mere question of pounds, shillings, and pence—a mere question of weight. If a 68-pounder will do a certain amount of damage, a shot double that size will do twice as much damage. It is not a matter of opinion, but a matter of calculation, and a matter of certainty. It is a mere question of the size and power of the guns. There can be no doubt that guns can be made, and I should like to see them tried.

Captain FISHBOURNE.—I may mention, in justification of that view which Captain Blakely has put forward, that, after a careful examination of the "Trusty," I found, wherever the shot was stopped, the whole side behind it was shaken literally into a bundle of fibres. You can quite understand that the state of the vessel's side had arrived at that point that with a very little more force the whole thing would have gone in.

MILITARY GYMNASTICS OF THE FRENCH.

By Andrew Steinmetz, Esq. Lieut. Queen's Own Light Inf. Militia. First Class Certificate, School of Musketry, Hythe.

[This paper was received after the close of the Session, but, on account of the importance of the subject at the present time, it has been decided to print it without delay.—Ed.]

Part I.—The System explained.

Section I.—*Elementary Gymnastics.*

1. An army of 800,000 men, capable of being expanded to 2,000,000, perfectly trained and full of ardour, panting for glory which they believe it their destiny to achieve, is a splendid contemplation to a professional eye. We cannot help admiring the wonderful development of France in the military point of view. One master-mind fashions the whole—and the mould is the utmost perfection possible at present. Excellent as the French soldier has always been, he will be found far superior by any future antagonist. The late Italian war has done infinitely more for France, in the military point of view, than by the cession of two frontier-provinces, masterly as must be considered this last idea. The experience of that, in other respects, somewhat equivocal campaign, has not been left unmeditated by the military genius of France. A system is now enforced, in military tuition, which bids fair to make the French soldier and French officer the best in the world—thoroughly prepared in all the physical and mental requirements of the soldier. Having recently spent three months in France—six weeks at Vincennes—studying the military organization of the French, I propose to give some account of that system, deeming it worthy of our adoption.

2. There are nine military schools or establishments in France, whence emanate all the proficients and instructors of the army in all its departments:—the *Prytanée Impérial Militaire*, at La Flèche; the *Ecole Impériale Spéciale Militaire*, at Saint-Cyr; the *Ecole Impériale de Cavalerie*, at Saumur; the *Ecole Impériale d'Application d'Etat-Major* (for staff-officers exclusively) at Paris; the *Ecole Impériale Polytechnique*, at Paris; the *Ecole Impériale d'Application de l'Artillerie et du Génie* (artillery and engineers) at Metz; the *Ecole Impériale de Médecine et de Pharmacie Militaires*, at Paris; the famous *Ecole Normale de Tir* at Vincennes—the fountain-head of all our modern musketry instruction; and, lastly, the *Ecole Normale de Gymnastique*, at the *Redoute de la Faisanderie*, near Vincennes, with three professors of the science and art of gymnastics, under a commandant, whose prominent characteristics are the highest intelligence and most exquisite politeness.

About 300 men and officers here undergo a course of training during six months, in order to act as "monitors" or instructors in their respective regiments and battalions.*

* "Regiment and battalion" seems an odd phrase in England; but the fact is that the

3. The instruction of gymnastics is under precisely similar regulations to those of the musketry instruction in the regiments of the line and battalions of chasseurs, &c.

The colonel is responsible for the gymnastic instruction of the regiment, the *chef de bataillon* in the battalions. The lieutenant-colonel directs the application of the rules and regulations.

The officers must be able to explain the requirements; but they are not required to have a verbatim knowledge of the explanations. Up to the age of thirty years, however, the lieutenants and sub-lieutenants or ensigns must be able to go through the exercises.*

On account of the paramount importance of what is called the *course cadencée*—"well-balanced *run*"—and the possibility of its frequent application in closing upon the enemy or seizing a position—all the captains, lieutenants, and ensigns must know its principles, and be practised in it. Its rapidity is 200 steps per minute, going over 4,000 metres (about 4,333 yards) in twenty minutes. Its duration must not exceed twenty minutes, excepting absolute necessity—nor must it be in an oblique direction.

At the "double," or in running, the men are advised to breathe only through the nostrils—keeping the mouth shut. Experience has proved that, by conforming as much as possible to this principle, a man can continue the run much longer and with less fatigue.

The superior officers of the battalion must occasionally lecture the officers on the theory—"the theoretical principles" of gymnastics.

The non-commissioned officers are instructed by the adjutant.

A captain is specially charged with the instruction of gymnastics—first as to the practical instruction of the officers—the formation of instructors from the most intelligent of the non-commissioned officers and privates—and, lastly, in training the men who have had no previous instruction.

The captain has under him a lieutenant or an ensign appointed by the colonel in each battalion. He makes an annual report to the lieutenant-colonel of the condition of the non-commissioned officers, corporals, and soldiers required to assist in the instruction; and these soldiers are selected according to their aptitude, an equal number, if possible, in each company.

No dispensation from service is granted to these assistants—nor to the officers—excepting in cases of absolute necessity, and then only to the captain-instructor for the shortest possible time.

4. The gymnastic exercises are divided into five lessons:—first and second lessons, elementary gymnastics; third, fourth, and fifth, gymnastics applied to special purposes. A general progression regulates all the exercises.

French are more precise in this matter. Six or eight companies make a battalion, and four or three battalions a regiment, which last always consists of twenty-four companies. At present the 5th and 6th companies of battalions are at depôts, under a major, forming reserves of recruits.

* The French officer must either rise from the ranks or have passed through one of the military schools, where he has been made to pass through the ranks equally well. All French officers, therefore, are either well educated or well trained, and know their business thoroughly. I was particularly struck with their old heads on young shoulders. Another striking feature was, that they like nothing better than to "talk pipeclay;" nothing seemed to delight them more than military conversation. No doubt that in time this feature will be apparent in our mess-rooms also, when our necessary examinations shall have compelled the production of military students, who will have no ignorance to hide, nor be ashamed to betray it to gain instruction.

The men are divided into three classes. The third class comprises all the recruits: they are exclusively practised in the first lesson of elementary gymnastics during the first fortnight of their enlistment, and before they proceed to drill. The second class comprises those soldiers who have not been admitted into the first class; and the first class is composed of men who perform with precision the first four lessons of the general progression. When those of the second class are fit to enter the first, they are admitted by order of the captain-instructor, who notifies the fact to the officer of the respective company.

The practice of the first class takes place by companies, under the responsibility of the captains and the commanding-officer (*chef de bataillon*). Twice a month, on days fixed by the colonel, all the officers must be present. The practice of the second and third classes takes place under the direction of the captain-instructor and the officers, non-commissioned officers, corporals, and soldier-instructors or assistants.

The first class practises twice a-week; the second class, three times a-week; the third class, twice a-day, until the men have commenced their drill, and then once a-week. Each practice lasts one hour and a half. When intense cold or heat requires a cessation of the practices, the lieutenant-colonel applies to the colonel for an order accordingly. A permanent exemption from the gymnastic exercises is granted to the officers by the colonel, after having taken the opinion of the surgeon, if necessary; and, in like manner, to the non-commissioned officers and soldiers, at the recommendation of the medical officer.

"Returns" are drawn up, recording the zeal and progress of the men, as in musketry instruction; and the captain-instructor has to send in, every month, to the lieutenant-colonel, similar returns as to the general progress of the instruction, so that the number of effectives of each company may be accurately known.

"None but the prescribed exercises are permitted by the instructor: he must never allow the men to attempt any extraordinary or exaggerated feats of strength or dexterity that might cause accidents or injure the soldier. His aim must be to develope the strength, agility, and dexterity of the soldier by a wisely regulated exertion, and inspire him with that self-confidence and energy which the various occasions of his military life may demand. He must strive to rouse the pluck and emulation of the men by rendering the exercises as agreeable and as easy as possible, taking all necessary precautions to prevent them from injuring themselves or becoming discouraged. He must never forget that the perfect safety of the soldier under training, the pleasure of the various exercises, and, above all, the soldier's own desire to excel, are the first and secret elements of success in gymnastics. Harsh treatment must be carefully avoided, much more anything like turning his efforts into ridicule when he fails, or punishing him for involuntary awkwardness. Nor must he be required to maintain a strictly military attitude in these exercises, which will only uselessly fatigue him as far as our object herein is concerned; nor must we check too severely those spontaneous manifestations of enjoyment and humorous delight which he may betray, since they are but the natural, and, indeed, fortunate results of the exercises when properly directed. In conclusion, we must not expect more than regularity, precision, and relative

perfection in these exercises, to which a military form has been given merely to facilitate their study and their application to the whole army." *

6. The men practise in their fatigue dress, and are provided with a belt. In squads of ten or fifteen men, they are drawn up precisely as for our preliminary drill without arms.

The first exercises are intended to make the body supple from head to foot—*propres à l'assouplissement*—turning the head from right to left, forwards and backwards, or merely towards the right and the left, bending the body forward as in our extension motions, raising the arms vertically, with and without bending them, flinging out the right or left arm, fists clenched, and describing a circle of which the arm is the radius. The instructor commands:—1. "Head to the right and left." 2. "One, two." 3. "Steady." At the commencement of *one*, the soldier turns his head very slowly towards the right shoulder, as far round as possible. At the word *two*, he turns his head to the left in like manner, and continues the movement alternately. At the word *steady* his head resumes the position of *eyes front*. These words of command are repeated for the other head movements, the instructor taking care to see that the movement of the head does not turn the shoulders. Other words of command are—1. Attention. 2. Circumduction of the Arms. 3. Commence. 4. Cease. Or—1. Attention. 2. Horizontal movement of the fore-arms. 3. Commence. 4. Cease. Or—1. Attention. 2. Extend the arms sideways and vertically. 3. Commence. 4. Cease.

No soldier marches so easily as the French. It is the result of his method of learning to march. There is the "moderate cadence," 76 movements per minute; the "quick cadence," 150 per minute; and the "running cadence," 200 per minute. In "marking time" the words of command are—1. Attention. 2. Flexion of the leg (moderate, quick, or running). 3. March. 4. Halt.

At the word *march*, the soldier bends the left leg behind *as high as possible*, keeping the thigh and body straight, then bringing the foot to the ground: the same movements with the right leg.

They are next practised in bending the thigh and the leg. 1. Attention. 2. Flexion of the thigh and leg (moderate, quick, or running). 3. March. 4. Halt. At the word *march* the soldier raises the left knee, the thigh being placed horizontally, the leg naturally falling, the point of the foot lowered and slightly turned out. He then brings the foot to the ground, and executes the same movement with the right.

In both these exercises the head, the body, and the arms must be kept in position.

In the moderate and quick cadence, the foot comes flat to the ground, the point of the foot touching it first; in the running cadence, the movement is an alternate hopping on the points of the feet. These exercises are also performed with the hands on the hips, the words of command being—1. Hands to the hip. 2. Flexion of the leg, &c. 3. March. The hands are placed on the hips precisely as in sword exercise.

It is obvious that this mode of teaching to march must enable the soldier to avoid the great cause of universal bad marching and walking, namely, the bringing the heel to the ground, thus shaking the whole

* *Instruction pour la voltige militaire.*

body, and especially the spine, and consequently distressing the brain and lungs. By the great elevation of the legs, the soldier *must* habituate himself to bringing the toes first to the ground, instinctively to avoid the shock, especially in the running cadence or double. During the practice, the soldier repeats the words *one—two* as each foot comes to the ground, in order to practise the lungs at the same time, and also to give a rhythm to the performance.

In order still more to direct locomotion to the fore-part of the foot, there is the following practise:—1. Attention. 2. Flexion of the lower limbs. 3. Commence. 4. Cease. At the second command, the soldier brings both feet together, throwing the weight of the body forward. At the word *commence*, he slowly lowers his body by bending his hams, so that the thighs touch the calves of the leg, the arms falling beside the body, the weight of the body being entirely thrown on the points of the feet. He then rises gradually to the erect position.

There is also what is called "the gymnastic chain;" circles are traced on the ground in which the men are posted, in a single rank, three paces apart. The instructor commands—1. Squad will advance. 2. Double (*course cadencée*). 3. March. 4. Halt. At the first word the soldier throws the whole weight of his body on the right leg. At the word *march*, he throws the left foot smartly forward, the leg slightly bent, bringing the point of the foot to the ground thirty-nine inches from the right, and so in like manner with the right, always keeping the weight of the body on the leg which feels the ground, allowing the arms to take their natural motion. The first man (a monitor, or one of the best trained) runs successively through all the windings of the chain without stopping, the others follow, preserving the distance. When the men meet each other at the intersections of the circles, they shorten or lengthen the pace, so as not to jostle each other, and so that two men shall not pass by the same interval.

To deliver a thrust or a blow to the best advantage requires training of the subsidiary muscles, and such practice as places the body in the best position to aid the effect. This is done by the "Pyrrhic Exercise." 1. Pyrrhic Exercise (right or left limb forward). 2. Ready. 3. March. 4. Halt. At the word *ready* the soldier faces to the left, carries the right foot forward, the heel sixteen inches from the hollow of the left foot, the right knee bent, the left leg stretched, the right arm extended forward, the fist clenched, on a line with the shoulder, the nails slightly upwards, the left arm in a line with the left side and but little bent, fist clenched and about six inches from the thigh, the nails towards the thigh, the upper part of the body inclining forward, the head erect, the eyes looking to the front, the left shoulder lowered. At the word *march*, the soldier straightens his body, bringing the right heel near the hollow of the left foot without touching the ground, turns at the same time his right fore-arm so that describing a circle from below upwards, the fist lightly touches the right breast, then flinging the fist smartly forward, the nails a little upwards, and advancing the right leg to about twenty-five inches, the foot striking the ground with force, or an "attack," as we call it, the upper part of the body forward, the left leg stretched, the foot flat, the left arm turned outwards and along the thigh as before. These move-

ments are continued until the words *company—halt!* when the soldier faces to the right and comes to attention. The left arms are practised in like manner, and a rhythm is given to it by the repetition of numbers 1, 2, 3, by the soldier.

7. There are six positions for the practice devised to teach the soldier how to maintain the equilibrium. He stands alternately on the right or left leg, bending the other against the body with his locked fingers, or he stands on one leg, the other bent behind; or he comes slowly to the kneeling position and springs up smartly, flinging his arms suddenly above his head, the nails turned inwards and comes to attention; or he bends forward on one foot, or backwards in like manner, and to the right and left, all on one foot.

8. The elementary development of the muscles forms a most important part of the training. By word of command the men strike their breasts with the right and left fist—strike out with the right and left as in boxing—support cannon-balls in the hand, one or both arms extended—and hurl the balls to a distance. They fling an iron bar, held by the middle—they support a heavy club in every possible position, at the shoulder, behind the back, one with the left hand, another with the right, at right angles, or two together one in each hand. They swing the club horizontally and overhead, or vertically and behind, or round and round the body.

9. Preparatory to leaping, the proper muscles must be taught their contractions, and this is done by the words of command:—"Simultaneous flexion of the legs;"—Simultaneous flexion of the thighs and legs;—and then they hop on the right or the left leg singly, and then on both together. They are practised in advancing in the position of kneeling on one leg alternately—obviously very useful in changing position behind a low wall or a hedge.

10. They are taught to walk systematically on the heels alone, and on tip-toe, and to fling the cannon-ball with the foot by means of a strap attached to it. As practice alone can habituate us to the proper inclination of the body in ascending and descending, both these modes of marching are carefully taught, attention being fixed to throwing the weight of the body on the point of the toes in the former, and on the heels in the latter.

11. Their wrestling takes every mode of contest. With extended arms—the fingers interlocked—the left leg advanced—they push against each other; or, holding each other by the hands, or by the wrists, they pull against each other; or each man holding his left wrist with his right hand—the thumb underneath—seizes with his left hand the right wrist of his antagonist, and then, at the word "*Wrestle*," he pulls or pushes uniformly or otherwise, to the right, to the left, forward, to the rear, upwards and downwards, striving to displace his antagonist.

Provided with appropriate handles, with a short cord attached, they pull against each other, each striving to drag his antagonist with one hand, then with both hands; and then three wrestle together in like manner, the central man pulling or resisting the outer two, or both of these pulling against him in opposite directions.

Then two wrestle in a sitting posture:—they sit, closing the legs feet to feet, and sole to sole, with the aforesaid handle and cord between their feet, and at the word of command pull away, striving to raise each other.

As soon as one is raised the contest ends, and the victor holds the handle in his left hand. The instructor then makes all those wrestle together successively who have won the handle, until only two remain, and then ascertains the strength of these two by a dynamometer, and makes a note of it.

12. The last of the elementary exercises are those of traction and drawing against each other, holding on by a rope, either in pairs, or several together pulling against a fixed point, which may be a dynamometer indicating the force of the combined pull, or the men are divided into two squads and pull against each other.

13. As most of these exercises admit of a rhythm or cadenced sound emitted by the men themselves, this is strongly recommended. It certainly gives additional animation to the scene. Indeed the cultivation of the voice is considered eminently essential in the course of gymnastics. Singing exerts a salutary influence on the chest, and it is incontestable that it will be the means of powerfully acting on the *morale* of the *French* soldier, at all events, by teaching him songs of patriotic and martial import.

The singing lesson at which I was present was particularly interesting. The system is one recently invented, wherein the ordinary notes are represented by arithmetical numbers—thus occupying about one-third of the usual space. Pointing by means of two canes to each representative number is all that is required of the instructor. The pupils, about 300 men and officers, intoned the notes with admirable precision. When the instructor opened out the two canes, they made a *crescendo*, and when he closed them gradually, it was a beautiful *diminuendo* "in linked sweetness long drawn out." There was then sung a concerted piece in two parts, extemporised by the highly gifted commandant, who figured it on the black board. It was at once most accurately sung—first and second so admirably concerted, that the whole seemed as it were an organ of human stops—alto, tenor, and bass harmoniously blending.

Section II.—*Applied Gymnastics.*

1. The exercises of this section must be directed with extreme prudence. Care must be taken by the instructor that the emulation of the pupils should not degenerate into a spirit of rivalry, instigating them to dangerous efforts.

During cold weather they must abstain from executing leaps that require violent efforts: at all times, those who are not perfectly disposed should not be required to leap at all.

Carelessness and inattention to the rules can alone cause those accidents apprehended in these exercises.

The dimensions of the obstacles to be leaped over must be gradually increased: but no *downward* leap must ever exceed sixteen feet—five metres.

The words of command are:—1. Attention; 2. Forward—Leap—*one, two, three.* At the second word, the man closes the points of the feet; at the word *one*, he stoops on his lower extremities, slightly raising the heels and stretching his arms to the rear, the fists clenched; he then rises again, the arms hanging naturally down. At the word *two*, he repeats the

movement: at *three*, he recommences the same movement, stretches the hams vigorously, throwing his arms forward, leaps the distance or over the obstacle, falls on the point of his feet, stooping down, and then comes to attention.

The same principle is observed in all leaping, whether it is to a height, downward, or forward and downward—the only difference being in the position of the arms: in leaping upward, his arms are flung overhead to aid the ascent, the same in a downward leap: but if the leap be *forward and downward*, he begins with the arms in advance, and places them perpendicularly for the fall. The reverse takes place in leaping *forward and upward*. Thus they practise leaping in every possible direction—upward and downward combined—upward, forward, and downward—to the right or to the left—to the right and to the left and downward combined, the arms being directed accordingly. They leap *backward* precisely in the same directions, and according to the same rules. In leaping backward from the top of a wall, the man first takes a glance at the descent, turns, closes his feet—the heels projecting over the wall, stoops—the upper part of the body being forward, places his hands outside his feet and seizes the edge of the wall, the four fingers above, the thumb underneath, and thus flings himself backwards, his arms overhead. When there is width as well as depth in the backward leap, the body and the legs are flung off almost horizontally.

The running-leap is performed in a manner similar to those previously described—the run being quickened more and more up to the moment of springing forward. Some of the leaps I saw performed were from fifteen to twenty feet. As a complement to these leaping exercises, the ground may be prepared with various objects to leap over, such as benches, tables, heaps of stones, &c.

2. The men are also progressively practised in all these leaps carrying their arms and baggage. The downward leap in such cases must be restricted to thirteen feet—four metres. The soldier holds his rifle balanced at the trail with the right hand, the muzzle slightly raised, so as to prevent it from touching the ground; he holds his sword with the left hand.

When the soldiers have become familiar with leaping, the difficulty is increased by rendering *moveable*, first the point of departure, and then the point of the fall, and finally both these points are made moveable. To leap *from* a body in oscillation the soldier leaps at the moment when the body is rising; to leap *on* a body in oscillation he leaps at the moment when the body is sinking. There is great danger in leaping from an object in rapid motion; in case of necessity the soldier must face in the direction of the motion, and at the moment of quitting it he must lay hold of it, shortening his arms, and so push himself backwards, lengthening his arms.

It is a general principle that in leaping from a height of any extent the soldier should avail himself of anything at hand to diminish the shock.

3. The circumstances in which leaping must be resorted to are often unforeseen, and require prompt decision; it is therefore important that the men should be taught the following principles, to apply them spontaneously on all occasions;

1st. *To form a rapid judgment of the obstacle, and also of the ground on either side.* We scan the ground in advance of the obstacle in order to make a good choice of a footing for the leap; if the ground is too smooth the foot may slip; on soft ground there cannot be a good footing for the leap. By scanning the ground beyond the obstacle we select our landing-place, and we foresee what difficulties we shall meet with. A difference of level between the point of departure and fall modifies considerably the extent of the leap.

2nd. *During the leap the breathing must be restrained, and the air with which the lungs have been previously filled must be expired the moment the man reaches the ground.*

3rd. *In leaps in width and height, fling out the clenched fists in the direction the body is to take, so as to augment the impulse given by the legs.*

To prove the utility of this principle, the men in leaping sometimes hold in each hand a grenade of two pounds weight, or a four-pounder. With this auxiliary the width of the leap is augmented.

4th. *In downward leaps, raise the arms vertically as soon as the body begins to descend,* in order that the body, reaching the ground on the point of the feet, may sink vertically without losing its equilibrium. If a man leaps into water, he places his arms at his side, his hands on his hips, the feet close together, the points of the feet lowered, the body stiff.

5th. *During the whole time of the leap keep the arms in the parallel position they have at its commencement,* to preserve the equilibrium of the body.

6th. *In forward or wide leaps incline the body forward,* in order that the oblique action of the legs on the body may be more efficient.

The recommendation to precipitate the last moments of the run preceding the leap, has the important advantage of enabling the man to incline his body as much as possible.

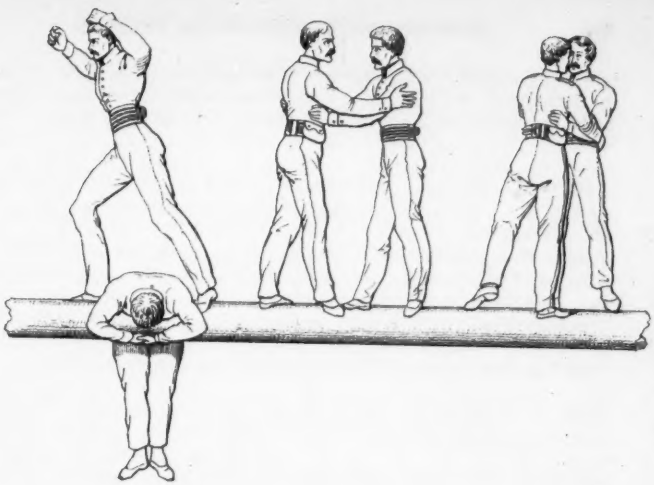
7th. *Fall on the point of the feet, the legs close together, bending all the articulations of the body from above downwards,* in order that the shock be not transmitted to the head without being lessened and attenuated by numerous decompositions of the force. The articulations of the feet concur efficaciously with this result, and it would be dangerous not to avail ourselves of them by falling on the soles of the feet, especially the heels, as previously explained.

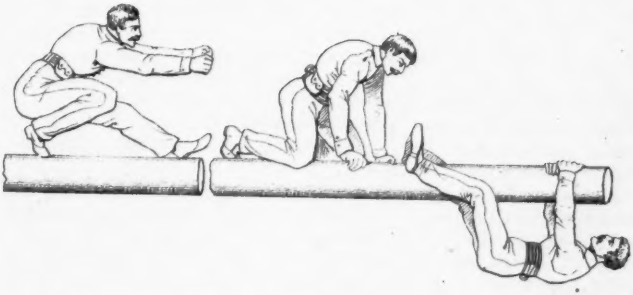
8th. *Avoid too rough a fall, by giving to all the articulations a general and supple "setting up," so as to make a light bound on landing.*

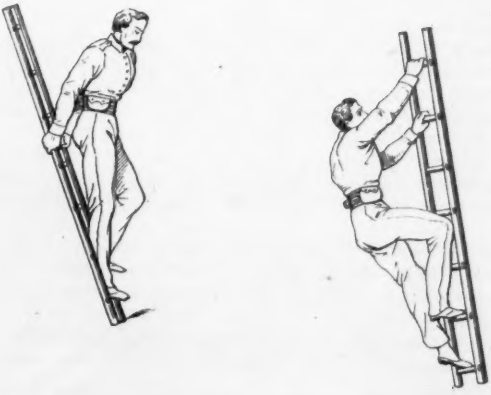
9th. *On landing avoid all useless motion, allow the muscles to relax: their continued contraction and rigidity would interfere with the body's equilibrium.*

4. In leaping with poles, they use poles of different dimensions, beginning with the smallest, not longer than the rifle, and finish with long ones from nine to twelve feet in length. The man seizes the pole higher or lower, according to the distance he has to leap. Of course perfect success in this exercise depends greatly upon the energy of the effort, and the long and rapid run by which it must be preceded. They also leap with two poles together from a height, the poles being planted parallel, and about two feet apart.

5. The exercise with suspension bars enables the soldier to use his body as he pleases, in any possible position, provided he can get hold of







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anything. Its beautiful and splendid result is extraordinary strength of arms, legs, hands, and fingers. Indeed, these suspensions of the body by the hands, the elbow, the legs, by one hand, one leg, one finger, in every possible position, show how the men are prepared for the thousand casualties of the assault.

They are also taught to move the body thus suspended by one hand from the bar, and to climb ropes after the manner of sailors.

6. Horizontal beams are raised at various heights from the ground. On these they learn to preserve a perfect equilibrium—sitting, moving along them by the hands, supporting the body which is free to fall, and, finally, walking erect upon them like a rope-dancer without his balance-pole. In these ticklish positions they meet and pass each other—simulate a fall and recover: the beams may be inclined or set in motion, it matters not; they hold on and do their work equally well, and drop to the ground without injury. (Plate I.)

They are taught to pick their way over scattered boulders or stakes driven into the ground; and it has even been thought proper to teach them how to walk systematically on stilts.

7. They are taught swimming—all its necessary movements before they go into the water; and many, I was told, strike out at once, at the first trial, thus proving the efficacy of the well-considered system. In the water they are practised in performing the feats required in actual warfare, carrying their arms and accoutrements in a variety of ways according to the supposed circumstances of a campaign.

Of course, if the men are taught to swim, they must be sent regularly into the water. This regulation, therefore, ensures personal cleanliness, the first rule of health, which is much needed in *our* army, where a clean shave and cropped hair are all that we insist on, and, consequently, a march or a drill does not impregnate the air with the spice of Araby, or the refreshing emanations of Piesse and Lubin. The mortality of our army is said to be above the average: it should naturally be less, as nothing conduces more to long life than exercise, regular hours, and rational discipline.

8. With a view to *escalading*, the French soldier is assiduously trained in all the shifts of ladder-mounting, with ladders of wood and ladders of rope; and he becomes as good as a sailor in pulling himself up a rope, either looped, knotted, or smooth, from the ground to any reasonable or unreasonable height. If a scaling ladder be not at hand, a tent-pole, or any pole will do to enable him to get to the top of a wall or the crest of a parapet. He is actually taught nine different modes of performing this achievement so flattering to the ambition of the French soldier. (Plates I. and II.)

The scaling of a represented turret was something beautiful to see. "In the twinkling of an eye," or "done in no time," can alone describe the rapidity of the exploit.

9. And they are taught to mount a wall without any instrument whatever, with the feet and the hands and the fingers alone. Bullets and cannon balls leave holes in the strongest walls; these are represented on the wall of the Gymnasium, and thus they practice this last resort of the resolute and determined besiegers. If there are no holes, no *points d'appui*, it will not matter; they build a pyramid of men, four at the base, two or

four perched on the shoulders of these, and one on the shoulders of the latter by way of apex. (Plates II. and III.)

10. They have adopted all the feats of the *trapèze*, as performed by acrobats; they tend to strengthen the arms and promote that self-reliance and confidence which are the prime elements of a good soldier. Some of their swinging leaps with it were prodigious, from one end of the gymnasium to the other, where they alighted, and caught on the top of the wall, and descended with hand and fingers as before described.

Flying leaps on and over a wooden horse is practised in every possible direction; and the French cavalry are required to be able to leap on their horse from the rear whilst galloping, and to leap over a hedge or barrier together with him, but on foot, holding the reins. It is impossible to believe that very many can do this, but that is the aim, and the higher the aim the greater the effort; and something worth having is sure to be done, even if we fail of the highest attainment.

11. The most laborious of the practices is probably that of carrying at the top of their speed (the *course cadencée*) all the implements of war, fascines, sand-bags, gabions, projectiles, &c. or sacks of sand, whose weight is progressively increased from 20 to 50 lbs. They must also practice carrying ladders, beams, caissons, dragging gun-carriages, &c. and they are equally habituated to carry rapidly and skilfully the wounded from the field of battle, by placing men on litters or any substitute at hand, in the Gymnasium.

12. Sword exercise, bayonet exercise, boxing and fencing are also taught, but only the rudiments. In the regiments and battalions they have more opportunities of perfecting themselves in these accomplishments. It was rather odd to find that the fencing was confined to its elementary passes and parries: but the fact is, the authorities do not wish to impart much skill in this matter, thinking of its consequences as to duelling in the army.*

13. There was one exercise which I never before saw performed by any one but a clever Hindoo in the streets of London. Armed with a stick about two yards long, the gymnast went through a variety of vertical, oblique, and horizontal movements with it, seeming to prove that a rod of iron of the same dimensions would, with such skill, completely keep at bay three or four antagonists armed with the sword or with the rifle and bayonet. A light cavalry carbine provided with sword-bayonet might be practised after the manner of this true "single-stick."

14. Such is a succinct account of the military gymnastics of the French. The 300 various feats and practices have only one object—preparation for the possible and probable casualties of war; but they have meanwhile the

* Here I may state a fact not generally known, that in the French army duelling amongst the men—with the sword—is not only permitted, but sometimes commanded by the colonel. A soldier must not fight without leave, and the colonel may grant it if he thinks proper. In this case, if the man is disabled, he becomes entitled to his pension for the wound. The offending party in disputes or broils is sometimes required to "give satisfaction" in a duel, ordered by the colonel, in addition to his other punishment. It is supposed that people guard their tongues, and restrain their fists all the more, if they know that they run a chance of being pinked in a duel. It should, however, be mentioned that, in such cases, the *maître d'armes*, or fencing-master of the regiment, always stands beside the combatants to parry off any thrust or cut likely to be critical.

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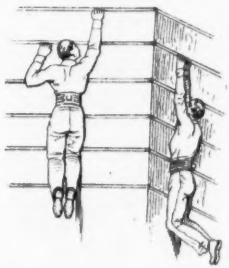

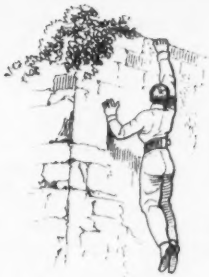

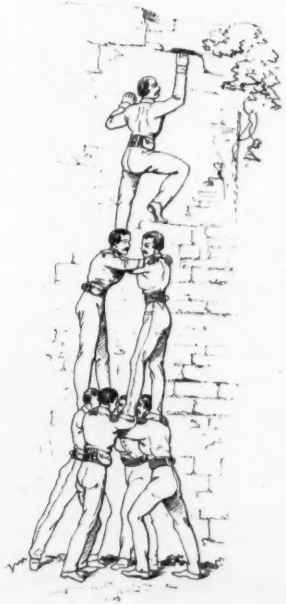

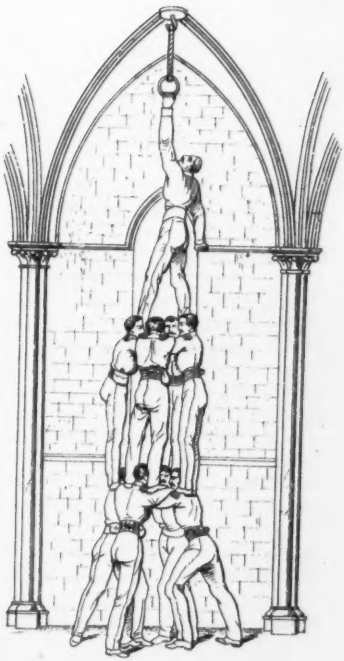

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positive effect of giving the men the utmost freedom of motion—*aplomb*, self-reliance, and the very useful self-estimate in the soldier that he is superior to every other in the world. Depend upon it he will not be easily disabused of that opinion. It will take a vast deal to knock that conceit out of him.

PART II.—THE ADVANTAGES OF THE TRAINING DEMONSTRATED—WITH REFERENCE TO THE NECESSARY TACTICS OF FUTURE BATTLES, RESULTING FROM THE INTRODUCTION OF THE RIFLE AND RIFLED CANNON. THE FRENCH CHASSEURS, &c.

All who have recently witnessed the performances of the French soldiers, especially their battalions of *chasseurs à pied*, have admitted the success of French training in the formation of a perfect soldier.

The majority of the French army are certainly little men; but do we not err in England in our exaggerated "fancy" for big men? What have big men ever achieved but feats of brutal strength? And even this is only exceptional, the generality of big men being very rarely harmoniously set up, and almost always betraying some glaring deficiency, especially in the head; whilst all history proves that little men have been the great ones of the earth—in every department of human distinction. Little men have instructed, poetized, evangelized, legislated, ruled, regimented, sculptured, pictured, doctored, and conquered the earth.

We have heard talk about their "shockingly loose drill" and "short step;" but, without admitting that the former is strictly correct, I would suggest that our admirable precision sometimes exhibited in some "crack" regiments will be as nothing in the field of battle, compared to that training which they are now about to have, which will keep them always "in condition," and give them not only a ready and constructive use of their intelligence, but also the utmost nimbleness of motion and hardihood of which they are capable, being confessedly the best material in the world for soldiers.

Napoleon said (at St. Helena if I mistake not) that he would conquer the world with British soldiers and French officers.

Of the French chasseurs of the present time—the veritable hand-artillery of the French army—it has been said by a competent Prussian officer: "At the first glance you see that they are a picked body, chosen from the best men of the wood and mountain districts. They are well-knit, compact, strong, and yet so wonderfully nimble! As they flit about with astonishing rapidity, you recognise their enterprising spirit, their daring pluck, their quick intellect, their indefatigable endurance, though, certainly, you also recognise their immense conceit and French vanity; and wherever you see them—in Strasburg, in Paris, or in any garrison—they always make the same impression—they look as though cast in the same mould.

"At their head I saw none but young officers. A few only of the captains appeared thirty-five, most of them less, and even amongst the field officers not older.

"Their rapid mobility shows neither constraint nor effort. Constant exercise

appears to have made it their second nature, with such ease and freedom do these battalions go through their movements. Their blood has a more tranquil flow—their breathing is less disturbed than that of other men. Single orderlies would pass, in a short time, all persons walking before them; and at the same quick pace, whole battalions, at the merry sound of their bugle, defile through the streets. Wherever they were seen—on the drill-ground, on the march out, or at home—never did they seem tired to me. Ambition, in this matter, may go hand-in-hand with habit. If quickness of motion and steadiness of aim appear to be irreconcileable, the chasseurs seem to have overcome this apparent incompatibility. If their steadiness of aim is at all disturbed, it certainly must be so in a degree very little affecting their efficiency on the field of battle. In Africa, where many an engagement was preceded by similar marches at the double, they have always known how to hit their opponents; and this proves that the special system of training to which they are subjected, tends to properly develope the powers of the body, and does not destroy steadiness of aim. With troops not so trained this would, of course, be very different.

"The great advantages of this system of training are evident. Many are the cases in war in which it may be of decisive importance that your infantry should be capable of quicker locomotion than it is at present,—for instance, in anticipating the enemy in occupying an important position, in rapidly attaining a commanding point, in supporting a body engaged by superior forces, or in surprising the enemy by making a detachment suddenly appear in a certain direction quite unexpectedly."

It is certain that Marshal Saxe's maxim, that in battle all depends upon the legs, will more than ever be verified. It is not length of step that is required, but rapidity of motion, and the ability to keep it up the longest. Twelve, fifteen, and over twenty miles continuous march, alternately at the quick and the double, is an ordinary affair with the chasseurs. The ease of their marching is acquired by the mode of preliminary instruction before described. In marching, they have learnt to keep the feet as close as possible to the ground, which gives them the appearance of gliding, the upper part of the body being always steady. It is a question whether our longer step, as prescribed by the regulations, is ever practically taken; at all events, it has never seemed to me that I got over more space when walking beside the chasseurs in their march. However, it is worth knowing that by quickening the steps we fatigue the body much less than by lengthening the pace.

In heavy marching order they are made to run and leap for a whole hour, so that the space gone over in the steps taken would be equal to five miles of ground.

All their field movements and evolutions are performed at the double. They form square, break into column, open out to wheeling distance and wheel into line, as consecutive evolutions, all at the double; and I never saw the least disorder during the movement, nor were any files left out.

Unquestionably the French army is quite prepared for the change of tactics more or less required by the longer range of modern rifles and rifled cannon. The emperor told them that such arms were dangerous only at a distance, and that the bayonet would be, as it always was, the terrible arm of the French soldier. They will close in as quickly as pos-

sible, and the battle will be decided by the suddenness of attack and the unabated vigour of practised hands, lungs, and legs.

The recent alterations in their battalion drill consist in simplifications, ready combinations, and easy conversions, all with the view of saving time, and being ready to take advantage of every turn in battle.

In skirmishing they form squares of contiguous fours, of contiguous eights, for mutual defence against cavalry; and, besides the usual square of the line, the skirmishing party will run in and form a solid *circle* with the reserve; and then they "reform companies" by a simple right and left face, quick or double march.

The bayonet exercise is indefatigably practised throughout the French army; and there is no doubt that both officers and men believe that it will do the chief work in future battles. I asked a chasseur what was the "figure of merit" of his battalion; he said, "About 50 per cent., but we don't care much about firing." "What then?" I asked. "The bayonet," he replied, placing himself in position; and adding, "at Magenta the battalion didn't fire a shot; but we made lots of prisoners."

They have simplified the bayonet drill—retaining only 24 movements, easily learnt, and admitting of the greatest dexterity in attack or defence. This return to the heroic hand-to-hand encounter of early times is a curious fact. The use of fire-arms separated combatants; and now their perfection will bring them again front to front, and foot to foot,—"on mutual slaughter bent."

I suppose, however, one side is sure to run first, in nine cases out of ten. During the whole of the wars of the Empire there were but two occasions in which the combatants stood the brunt, and went at it in right good earnest; the first in 1805, at the battle of Amstetten, when Oudinot's grenadiers attacked the grenadiers of the Russian rear-guard, and the engagement lasted some minutes. The second was in 1813, at Lutzen, when the 25th regiment of the line, piqued at the idea that the Emperor seemed to doubt its energy, fought the whole day with the bayonet without firing a shot. On the other hand, at the battle of Caldiero, two battalions, one French, the other Austrian, had been firing at each other for some time without results on either side, when the French, getting impatient, were ordered to charge bayonets. The Austrians instantly went to the right-about, although covered by a ravine which it was quite impossible to cross.

From a well-written pamphlet, I borrow the following very significant observations: "The real practice-ground for skirmishers is before the enemy; and here the French had a splendid school for their light infantry in the fearfully broken ground of Algeria, defended by the Kabyles—the bravest, most tenacious, and most wary skirmishers the world ever saw. Here it was that the French developed to the highest degree that instinct for extended fighting, and taking advantage of cover, which they have shown in every war since 1792; and here the Zouaves especially turned to the best account the lessons given to them by the natives, and served as models to the whole army. Generally a chain of skirmishers is supposed to advance in something like a deployed line, crowding together, perhaps, on points offering good cover, and thinning where they have to pass open ground; occupying the enemy's skirmishers in front, only now and then

taking advantage of a hedge or so, to put in a little flank fire, and, withal, not expected nor even attempting to do much besides occupying their opponents. Not so the Zouaves. With them, extended order means the independent action, subordinate to a common object, of small groups; the attempt at seizing advantages as soon as they offer; the chance of getting near the enemy's masses, and disturbing them by a well-sustained fire; and, in small engagements, the possibility of deciding them without calling in the masses at all. With the Zouaves, surprise and ambush are the very essence of skirmishing. They do not use cover merely to open fire from a comparatively sheltered position; they principally use it to creep, unseen, close up to the enemy's skirmishers, jump up suddenly, and drive them away in disorder. They use it to get on the flanks of their opponents, and there to appear unexpectedly in a thick swarm, cutting off part of their line, or to form an ambush, into which they entice the hostile skirmishers, if following too quick upon their simulated retreat. In decisive actions, such artifices will be applicable in the many pauses occurring between the great efforts to bring on decision; but in petty warfare, in the war of detachments and outposts, in collecting information respecting the enemy, or securing the rest of their own army, such qualities are of the highest importance. What the Zouaves are, one example will show. In outpost duty in all armies the rule is, that, especially at night, the sentries must not sit, much less lie down, and they are to fire as soon as the enemy approaches—in order to alarm the pickets."

Now read the Duke d'Aumale's description of a camp of Zouaves: "At night, even the solitary Zouave, placed on the brow of yonder hill, and overlooking the plain beyond, has been drawn in. You see no videttes; but wait till the officer goes his rounds, and you will find him speaking to a Zouave who is lying flat on the ground, just behind the brow, and watchful of everything. You see yonder group of bushes; I should not be at all surprised if, on examination, you were to find there ensconced a few couples of Zouaves; in case a Bedouin should creep up into these bushes to espy what is going on in the camp, the Zouaves will not fire, but despatch him quietly with the bayonet, in order to shut the trap." What are soldiers, then, who have learnt out-post duty in peace garrisons only, and who cannot be trusted to keep awake except when standing or walking, to men trained in a war of ruse and stratagem—against Bedouins and Kabyles? And, with all these deviations from the prescribed system, the Zouaves have been surprised only once by their wary enemies.

"England has, in the north-west frontier of India, a district very similar, in its military features, to Algeria. The climate is nearly the same; so is the nature of the ground; and so is the border population. Frequent forays and hostile encounters do occur there; and that district has formed some of the best men in the British service. But that these long and highly instructive encounters should not have had any lasting influence upon the mode in which all kinds of light service are carried on in the British army,—that, after more than twenty years of fighting with Affghans and Beloochees, the service should have been found so defective that French examples had to be hurriedly imitated, in order to bring the infantry, in this respect, into a state of efficiency—that is certainly very strange. The French chasseurs have introduced into the French army:

1. The new system of dress and accoutrements: the tunic, the light shako, the waist-belts, instead of the cross-belts. 2. The rifle, and the science of its use—the modern school of musketry. 3. The prolonged application of the double, and its use in evolutions. 4. The bayonet exercise. 5. Gymnastics. And 6. Together with the Zouaves, the modern system of skirmishing. And if we will be sincere, for how much of all this—so far as it exists in the British army—are we not indebted to the French? There is still plenty of room for improvement. Why should not the British army come in for its share? Why should not the north-western frontier of India, even now, form the troops employed there into a corps capable of doing that for the English army which the chasseurs and Zouaves have done for the French?" *

Are we not at the present time somewhat bewildered in our estimate of the rifle—somewhat infatuated in our expectations that the accuracy of the target-ground will be reproduced in the field of battle, and that the rifle, and nothing but the rifle, is the one thing necessary for England in her advancing day of struggle? The subject is worthy of serious consideration.

It is an incontestable fact, that in certain respects the old smooth-bore musket was a better weapon than the present rifle, especially against the charge of cavalry. Indeed, if cavalry officers were perfectly acquainted with the effects and behaviour of the new projectiles, they would drive into the enemy with more confidence than ever. The thing admits of easy explanation.

The great advantages of the new arms are accuracy and long range; but we have bought these advantages at the cost of precious qualities, especially in small arms, namely, a flat trajectory and greater penetrating force at the shorter distances. To drive the enemy from a position, we must absolutely march upon him, to tackle with him body to body, if he does not turn to the right-about; it is, therefore, for the decisive moment, the instant of the final shock, that we must be provided with the most crushing means of resistance and destruction.

Does this mean that we should return to the old smooth bore? By no means: but we must not exaggerate the efficiency of the rifle, and fancy that because the range has been tripled, and the probability of hitting a target has been equally increased, we are going to mow down an army in a few hours, as the reapers manage a field of wheat. Matters do not go on that way in war, and practice often gives some very provoking slaps in the face to theory. During the late Italian war both sides had rifles: the French had also rifled cannon. How was it that the mortality—the carnage, instead of being greater, was actually much less than in any previous wars? With the smooth bore of old, at Austerlitz, the loss of the French was 14 per cent. of their army, that of the Russians 30, that of the Austrians 44.

At Wagram the French lost 13 per cent., the Austrians 14.

At the Moskowa the French loss was 37 per cent., the Russian 44.

At Bautzen the French lost 13 per cent., the Russians and Prussians 14.

At Waterloo there fell of the French 36 per cent., of the Allies 31.

* Essays addressed to Volunteers. (Smith and Son.) An admirable pamphlet in every respect.

And now at Magenta, on the 4th of June, 1859, we find that the French lost seven per cent., and the Austrians eight per cent.

And at Solferino the Franco-Sardinian army lost ten per cent., the Austrian eight per cent.!

Now Magenta was a fierce encounter. At Solferino two armies disputed victory during twelve hours with remarkable pertinacity, and the result was that the losses on both occasions were much less than those of the least murderous battles of the empire. It cannot be said that the soldiers were inefficient: never did emperors of France or Austria lead their equal to battle; in fact, as far as the French are concerned, every French officer who was present will declare that the victories of France on these occasions were nobly won by the French soldier and the soldier alone. It cannot be said that the contending armies were widely distant from each other, on the contrary never was the bayonet more active. And yet never was the loss on either side less or as small in any previous battle. There is also this remarkable fact, that the conquerors, notwithstanding their rifled cannon, lost more men in killed and wounded than their vanquished enemies!

And the quantity of ammunition wasted was about the same as in old battles, with Brown Bess and her sisters. Guilbert calculated that in the battles of old, it required a million of cartridges to kill 2,000 men in a battle. Gassendi, in his time the oracle of artillery, thought that of 3,000 balls only one ever hit. Piobert, the great authority of the present day, calculates that, according to the results of long wars, 3,000 to 10,000 cartridges was the proportion to one man killed or wounded!

To make our whole population familiar with the rifle will certainly be a splendid result—of prodigious hope for the future; but let us not for one instant believe that our target practice is to be the criterion of our achievements in the day of battle. The hardiest, the coolest, the best trained soldier will be the best man on that day. We must rejoice exceedingly that military gymnastics will lend their aid to the development of our splendid material—the British soldier,—and that bayonet exercise will be practised with renewed vigour throughout the army.

The peculiar disadvantages of the rifle in regular warfare, resulting from the absolute necessity of complying, on the part of the soldier, with the conditions which it absolutely requires, must always be present to the military mind of those who are responsible for national defence and security.

In its utmost perfection the range of the rifle is 1,000 yards and upwards, that is to say when it has been perfectly constructed in every part of its multitudinous essentials; above all, the barrel, the bullet, and the all-important "sights," whose accuracy of graduation and position are certainly not things to be "taken for granted," and which the slightest shock may put out of order at any moment. There is scarcely a rifle in which allowance has not to be made for incorrect sighting. Who can do that in the crash of battle?

The rifle requires, as an "arm of precision," a vast deal of intelligence, tact, and steadiness of eye in the soldier. Is it not certain that at present, at least, the rifle is superior to the eye of the soldier—in other words, that his training is not equal to the perfection of his weapon? Sure and terrible

in practised and steady hands, it is certain that nineteen-twentieths of men will never be able to use it with perfect ease. Its trajectory or pitch is very high. At great distances the bullet plunges, and the "dangerous space" is reduced to a few yards. Nor is this dangerous space considerable in the mean distances. Thus, at about 1,000 yards, an error in sighting the range of about 16 feet,—and at 540 yards a like error of about 33 yards, would miss a target 10 feet high, and, of course, be clear over the heads of cavalry.

Within the point-blank range, say 250 paces, the soldier is exposed to the same variations; the trajectory is still sufficiently elevated to permit a man, and even a man and horse, to advance with impunity if the man stoops over his horse's neck, throughout half that distance, that is, 125 paces, supposing that the rifle is held horizontally. Hence we enjoin the soldier in such cases to fire low, that is to say, we leave it altogether to his own judgment or ability, as we do within 100 yards.

Now with the smooth-bore musket, within the distance of the rifle point blank, matters were very different. In aiming horizontally, that is, right at the breast, the enemy was hit in the thighs, and the hit successively ascended to the belly, the waist, and the stomach, at the distances of 200, 150, and 100 paces. In fact, the trajectory of the smooth bore, at short distances, was flat; the ball met a man who happened to be in the line of fire: the trajectory of the rifle, owing to the diminished velocity of the bullet by friction, can never be flat. If we could make the bullet spin without the loss of force by friction, of course the case would be altered; but that is impossible, and we must hit, if we can, only by the rules of firing being stringently complied with in every particular.

The consequences of this fact are obvious. The great curvature of the rifle trajectory necessitates a most exact estimate of the distance to hit the object. At great distances an error of a few yards would save a line of cavalry as well as infantry—and who can expect not to err by 5 or 6 yards in 900? At 540 yards an error of about 33 yards would have the same effect. Now we all know that an exact estimate of distance is prodigiously difficult—the very best judges of distance often making the most ridiculous blunders, misled by atmospheric or other causes not allowed for in the appearance of the man or object.

Rifled cannon have the enormous range of from 4,000 to 5,000 paces, with an accuracy never attained by the smooth-bore cannon; but, precisely like rifled small arms, the initial velocity of the projectile is weak, and, consequently, the trajectory is very high. "At great distances the ball does not ricochet; it buries itself with a plunge. The only dangerous point is that which it touches. If we fired in war as on the target ground, this gun would produce frightful results. It is very different in practice. At the distance of 2,000 paces the apparent height of a man is about 23 inches, and at 4,000 paces barely 12 inches. To distinguish at this distance a very good sight is required, a most exceptional sight indeed; and even then the air must be clear—there must be no mist, no vapour, no dust. To perceive the object does not infer the knowledge of the spot where it is, within one hundred yards; and had we a rifled cannon which could always make a bull's-eye at 5,000 paces, the probability of hitting at these excessive distances would not cease to be extremely small, since the

error of a few paces renders the projectile powerless. Of course the probability increases with the size and depth of the object; and this is the important feature of the new cannon.

Before their introduction, armies marched against each other in columns of various depths, and deployed at gun-shot distance, to begin the battle. Behind the line of battle were the reserves of infantry, cavalry and artillery, forming masses ready to lend assistance and support weak points, or to strike the decisive blow and make the *crisis* of the battle. At Waterloo, for instance, the columns of Napoleon deployed at 1,000 yards from the English position, and the masses of the reserve and the Old Guard at 2,170 yards from the formidable batteries of La Haie Sainte. Now-a-days these near approaches would not be admissible. Those deep columns, those immovable masses presenting an enormous target, would be decimated by shell. We must therefore deploy at double the distance, and then advance in line up to the range of small arms. As for the reserves, they must be concealed under shelter of a well-chosen position, or divided into small masses easy to move and unite; for we can no longer think of keeping them out of the range of artillery without compromising the chance of victory; the battle might end before our reserves could come up.

The necessity for exposing lines not engaged is not of a nature to intimidate brave troops led by intelligent officers. The latter will make a special study of the ground, taking advantage of every kind of shelter it may afford, hollows, bends, bluffs and hedges; and if these cannot be found, the troops will be divided into as many columns as possible, with small depth and consequent facility of movement.

As the fire of rifled cannon is very regular, and as the projectiles of a battery fall nearly on the same line, the officers will be able more easily to post their troops out of reach, in the rear, or in advance of, the trajectory.

At these great distances, the enemy's artillery will find it difficult to judge the results of their fire, or perceive the preservative movements of the troops; they will, therefore, continue to direct their shots on the abandoned position, and when they perceive their error, they will have to recommence their experimental trial at "sighting" and "judging distance."

In the advance, until the troops are in reach of the horizontal trajectory, the probability of being hit is still more diminished by the constant movement and rapid march of the enemy: the distance changes at every moment, and the dangerous space is very soon passed over.

Ancient artillery substituted for the inefficient solid shot and howitzer, grape-shot at short distances, and rolling balls, which, covering the field of battle with projectiles, rebounding on the ground, and raking at the height of a man's waist, were much more efficacious than the firing at great distances; and, in our day, the Belgian army had an excellent projectile, which carried grape-shot to the greatest distances, and which their artillerymen handled with great dexterity—the shrapnel, with metallic fusee, of General Bormann. The great accuracy of the new rifled cannon does not dispense with the use of grape-shot, or the ricochet, or the shrapnel; and there can be no doubt that a system of rifled cannon, which, together with accuracy and great range, does not combine in a sufficient degree the other advantages, cannot be reasonably adopted by an army as an exclusive field-artillery.

In the position of reserves the cavalry must prepare to charge at a greater distance, and remain longer exposed; but this is only what the whole army will have to do. The ground that the infantry must cross, under a more accurate and regular fire, is now *doubled*, and unless well trained and in perfect "condition," it may reach the enemy's position utterly exhausted.

It may be affirmed that at great distances firing on isolated men or deployed lines is tantamount to firing at random. It is seldom that the ground presents a sufficiently even surface to permit cannon to fire further than the rifle when firing effectively at 750 yards:—at this distance slopes and obstacles often conceal from sight not only a single man but entire bodies of troops,—or we are unable to get that inclination of the axis of the piece which is so essential to ensure good results. Of course we can show boards riddled with bullets at 500 and 600 yards or paces, and from this fact the annihilation of cavalry has been predicted; but such practice, in cold blood, with a cool head, at measured distances, lacks the experience of the battle-field; and, with Magenta and Solferino before us, the battle-field has demonstrated the exaggerations which mystify the peaceful frequenters of the target-ground. In a word, we must reverse all the conditions of the target-ground in calculating the performance of the marksman and his rifle on the field of battle.

But this is not all: if the probability of touching from afar, troops in position, whose distance is not accurately known, is very small, what will it be when these troops are in motion? Oddly enough, this part of musketry instruction—the very pith of battle practice—is but very faintly alluded to in *our* teaching, although certain rules approximating to certainty may be easily suggested and verified. Self-moving targets, if practicable, would of course be desirable. Still, with the utmost care, there will still be great difficulty. The constant change of place will necessitate a new "judging" of distance for every shot, a new adjustment of the sight and its consequent aim.

The elevating sight is decidedly a great disadvantage to the rifle in manipulation, although it is one of its most important qualities in the best conditions of its use. It is always troublesome, but much more so when aiming at an object in motion, because in the heat of fight the soldier may forget to alter the slide according to the distance, and then he must fire wildly, as occurred lately in China, firing over cavalry at 70 yards.

The French were so impressed with this serious disadvantage from their experience in the Crimea, that they suppressed the elevating sight in the regiments of the line, which up to 400 yards fire very well without it; they retain it only in their battalions of Chasseurs and Zouaves—the stalwart skirmishers of the French army. It is not their intention to allow the line infantry to fire at great distances, excepting on deep columns, or on objects whose distance is well known. Their substitute for the elevating sight at the greater distances is the thumb of the left hand; but this somewhat absurd device is in no favour either with men or officers, and it will not be retained. I was present at such firing at 600 mètres, and the waste of ammunition was ridiculous. Still, it may be effective against deployed lines. Some of the men fixed on the rifle the stiff cartridge paper by way of a slide, and these managed to hit the target; but the whole affair proved the necessity for contriving a better mode of dispensing with the elevating sight.

I am confident, however, that the thing is possible, and am prepared to carry out experiments with that view. I look forward to the time when our regiments of the line shall only have one fixed back-sight, and yet have a chance of hitting from within 100 to 400 yards—in my humble opinion, quite enough for the infantry of the line, if it can be achieved any how. But I also look forward to the time when we shall have battalions of British Zouaves, composed of the best men of our regiments—best in every requirement of the soldier, besides being "marksmen"—a company of whom shall permanently form the left flank company of every battalion of the line, and this company will have the work of "long range," thus saving the ammunition of the rest for the effective distances.

To train a body of men to act essentially and exclusively as skirmishers, is of the utmost importance; since every future battle is sure to be an affair of companies or battalions rather than brigades or divisions, as of old. In a word, much more will depend upon individual officers and men.

Without yielding to any one in the *adequate* estimate of the rifle, I do not hesitate to share the opinion that it has given no advantage whatever to the fire of the line. Indeed, we may be sure that it is less efficient at the short distances—the most decisive moment of battle. On the target-ground we strictly prohibit talking—the least disturbance that may distract the attention of the candidate for harmless distinction in complete security. How will it be in the ranks at volley-firing or file-firing: the soldiers excited to the highest degree, cannon-balls decimating the ranks, shells and bullets whistling their infernal tune overhead (which no one forgets, having once heard it), surrounded by smoke, amid the groans of the dying and the shrieks of the wounded? Do what you like beforehand —as we *now* do it—it will matter little; the soldier will simply raise his rifle to the horizontal, and fire without aiming. All will depend upon how much the rifle's *horizontal* can do, and with regard to the rifles now in use, that is decidedly very little. We must study the horizontal. All the veterans of the old battles affirm the fact that men cannot "aim," as we we are taught to aim, in battle. It was certain under Frederick II.; during the wars of the French republic; in all our battles before and since. The regulations, the "rules of fire," of the target-ground and Hythe, the "figures of merit" awarded and recorded so ostentatiously, are little better than vain delusions. At the supreme crisis alluded to the soldier cannot think of aiming at an enemy's feet, belly, or head, nor calculate distance. He directs his muzzle to the *breast* of the enemy—in a word, right before him horizontally. In the late Italian war, the firing by ranks which the Austrians had practised successfully during many years of peace, and which they had prescribed for the defence of squares, failed completely before the enemy. Nor was it any better with the French. In fact, when surrounded by dust and smoke, how is it possible for the soldier to do more than fire horizontally? We may rest assured that between 50 and 250 paces, with our present rifles, there will be more ammunition wasted than ever. It was different with Brown Bess: fired against deployed lines her lateral deviations were of little importance; her trajectory being flat, she mowed down everything within range, and it mattered not whether to the right or left. Hence the greater mortality of the smooth-bore battles over those of the rifle.

And then as to the probable behaviour of the rifle in "squares to resist cavalry." Our squares are splendid formations. At Waterloo the boldest of the French cavalry quailed before them. But let us suppose a square, armed with rifles, attacked by cavalry at the present day.

The cavalry, at 1,000 yards, will be in the range of the rifle. It will probably march 700 yards at the trot, 200 yards at the gallop, and 100 yards at the charge. It will get over the first distance in *three* minutes and the others in *one*. We will assume that the commander of the attacked square will not commit the enormous blunder of firing at the greatest distance, when the fire would be useless on a line advancing rapidly. Suppose he waits until the enemy gets to 500 yards—what's the result? "At 500 yards—ready!" The men make the adjustment, but before they have finished the distance is altered, since the horses advance at four yards per second, so that the "dangerous space" to cross is only during *seven* seconds! In other words, if the infantry fires seven *seconds* too soon, or seven seconds too late, not a shot will hit except by chance! Think of the effect on the men seeing the result of their precious fire. Will it not be enough to annihilate the soul of any man who is authoritatively assured that the rifle is placed in his hand "for the *destruction* of his enemy?" Think of the *moral* effect of such an incident in a square. The thing is hideous to think of. It is more than probable that there will be no "Kneeling ranks fire a volley!" on the *retreating* cavalry.

This result will not ensue if we teach our soldier to fire at the enemy as we fire in the sporting field, and give him a rifle that does not force him to lose such precious moments as seven seconds with cavalry dashing upon him like a hurricance or thunderbolt.

The French are perfectly aware of this possibility. One of their best officers, General Trochu, in one of the regimental theoretical conferences during the Italian war, told his officers, "If you are charged by cavalry, wait till they come up to forty paces. Then fire and be 'ready' with the bayonet." Now at forty paces the old smooth bore was better than the rifle, because, as before stated, the *initial velocity* of the ball was greater: it was about 500 yards—whilst the initial velocity of the French rifle and the Enfield is about 350 yards—and that of the Whitworth about 400 yards:* in the Swiss sharpshooters' rifle it is probably a trifle more—but all fall short immensely of the smooth bore. The greater the initial velocity with which the bullet leaves the muzzle, the flatter the trajectory: that's the problem, and there is no other for the rifle's trajectory. You will not get it by sharp "twist," nor mere "small bore,"—nay, all other conditions being equal—"sharp twist" infallibly lessens the initial velocity, besides the ultimate danger of "stripping" by fouling, or even without fouling, if the workmanship be not exquisitely well done, as in Mr. Whitworth's rifle. General Renard, of the Belgian army—whose views and facts I have been quoting throughout this summary—advances a still more startling fact as to the old smooth bore. Admitting that at great distances the rifle will bring down more horses and men, he contends that this can only happen at the comparatively slow advance of the commencing charge, so that the momentary disorder of the ranks will be easily rectified; but at the moment

* These approximations were given to me at Vincennes.

of the decisive charge, the rifle has not augmented the chance of loss, and the chance is still less for the *cuirassiers*. Thus, the old ball pierced a cuirass at thirty-eight yards—and, according to the experiments whose results I have seen at the same distance, the new bullets merely *indent* it." * In the lectures at Hythe we were told that similar experiments had been tried somewhere with Brown Bess, but they couldn't hit the cuirass at all! This is one of the ungrateful jokes against Brown Bess, who carried our flag triumphant from Egypt to Paris. Had a thousandth part of our present musketry instruction been given to the soldier with Brown Bess, perhaps we should not have talked so loudly and jocosely against her in her honourable retirement. In spite of all her defects, she "did her duty" as well as she could. *Resquiescat in pace!* and may her younger rival requite our confidence — as favoured friends should do, indeed—in the hour of need!

In spite of the defects of rifles and rifled cannon, owing to the great curvature of their trajectory, it is certain that we cannot do without them. An army with smooth-bore muskets and cannon, before an enemy armed with rifles and rifled cannon, would be in a sorry plight. Its batteries would be smashed—its skirmishers picked off—annihilated at ranges where its balls would be harmless, whilst its lines and reserves must be kept at a most respectful distance.

As to the rifle, on the other hand, we must remember, that although a very old invention, it is still in its infancy. Perhaps its improvements of late years have been more rapid than wise. Exaggerating the utility of long range, we have shut our eyes to the fatal disadvantages by which it is attended. Strategy and tactics will infallibly outwit long range: rapidity, accuracy of fire at short ranges, combined with such a condition of the soldier as results from good training—will, with determined hand-to-hand encounters, decide the contest in future battles. Of course the mortality will be less, because such a contest must necessarily be of short duration, unless the fortuitous conditions of the late Italian battles of the French and Austrians be taken as a model of fighting, although confessedly devoid of strategic or tactical plan from beginning to end, giving the entire glory of the contests to the French *soldier*—and the soldier alone—as generally admitted by their officers.

Training—careful, indefatigable training—has made the French soldier what he is. He was always excellent, as I have said, but he is infinitely better than he ever was in the best days of the empire. I speak emphatically of the chasseurs à pied—decidedly the finest troops in the world—and the cherished twenty battalions of the French army.

They are armed with a new rifle which, in spite of its large bore, is, in the opinion of the best judges on the continent, the best military weapon in existence. At 200 and 240 metres, more than the same number of yards, its accuracy is perfect; it gives good results from 400 to 600 metres, and even at 800 metres.

The chasseurs have been called the hand-artillery of the French army.

* "De la Cavalerie," p. 147. General Renard is a good authority; but we have certainly been taught in England that the rifle bullet has, at all distances, greater penetration. The General is aide-de-camp to the King of Belgium, and "Chef du corps d'état-major."

The "figure of merit" of all the battalions is about fifty per cent., practising twice a week. Their bullet weighs nearly 200 grains more than ours. I witnessed their firing repeatedly at Vincennes, and can testify to its excellence on all occasions.

The calibre of all French rifles—the entire army being now provided with rifles—is about eleven-sixteenths of an inch, considerably more than that of the Enfield; but they are now making a rifle of exactly the same bore; in other respects, however, in accordance with their superior scientific determinations. As most of the rifles are old barrels "transformed," they differ slightly in calibre, but they have all the same number of grooves, four, varying in depth, some uniform, others progressive, and from left to right, the twist being the same as in the Enfield.

With a positive view to raking horizontal fire, the natural point-blank of every normal rifle is 200 metres—about 217 yards. There are twenty different kinds of rifles, including the last model small bore, which I suppose is now under trial. The difference consists in slight variations of the calibre—the weight and length of barrel—depth of groove, &c., as before stated, but there are only two sizes of bullets for the great mass of the army—one for the Infantry and the other for the Chasseurs, Turcos, and Zouaves.

The French have retained the large bore on economical grounds; but, with their usual admirable method of scientific application, their exact military science, they have been able to render it perfectly efficient in its various "transformations." Besides, they think it an advantage to be able to use the captured ammunition of all nations at a push, whilst no other can use theirs, excepting the Swedes, who are not thought very likely to get hold of it.

The French assiduously train their officers as well as the soldiers. War rules everything in history, and if at present we are anxious, as in expectation of the thunder-cloud, let us remember that modern wars must necessarily assume wider proportions than ever, destroying more in one day than former wars did in entire years of conflict. By a single campaign the map of Europe and its colonial dependencies may be reconstructed. Woe to the people who are not ready, woe to the officer, who, on that occasion, does not know his business!

In war *theory* can more easily dispense with *experience* than experience can dispense with theory. Courage, pluck, and intelligence will be useless, nay often fatal, to the officer who has not studied his profession. In fact, the greater his courage and dash, the more will he be exposed to irremediable blunders.

The most instructive military book, perhaps, would be a history of all the battles lost by the mistakes of officers, from the general down to the lowest subaltern. Such a book would be far more valuable than the thousands which teach how battles have been won.

In France frequent "conferences" take place between the officers of a regiment, presided over by the colonel, for the discussion of such topics, and, as previously observed, to talk pipe-clay—that is, on professional topics—is not voted a bore so generally as amongst ourselves. Besides, the youngest subaltern is often mounted on horse-back and required to put the battalion through its evolutions—not merely giving the word of com-

mand, but being required to explain to all the other officers, their respective parts in the extemporised evolutions.

Favour goes a great way, no doubt, in the French army, as in every other; but it is equally certain that ambition, well founded on personal merit, has nowhere else so splendid a "chance" as in the imperial army at the present time. We seem to be working up towards the same desirable consummation in England, slowly, perhaps, but it must come to that at last.

In conclusion, I yielded to no man in admiration of that movement which has so strikingly revived and expanded the ancient instinct of the nation. What our ancestors did with the bow, we shall undoubtedly do with the rifle. This is a settled fact. But it must now be obvious, that mere accuracy of fire on the target-ground cannot be the only one thing necessary in preparing for our advancing day of struggle for the mastery.

The enthusiasm, and devotion, and success of our Volunteers emphatically contradict the hitherto frequent averment, that we are not a military nation. Indeed, a calm, a thoughtful, a philosophical study of our history, our achievements, our national character, prove clearly that the ancient Romans left in the population of Britain their salient characteristics, after their four hundred years' occupation.

Lavish laudation on the one hand, and "small praise" on the other, have been the lot of our Volunteers. This antithesis must be regretted. They are sufficiently intelligent, sufficiently patriotic to hear the truth, the whole truth, and nothing but the truth; but, above all, they wish to know what position they are exclusively to occupy in the defence of the nation, and up to that point they will manfully work and attain it.

At a very recent review, at Wanstead, General Eyre gave some excellent advice for their guidance to the Volunteers. He said: "Any of you who come down here ought to do so to take advantage of this ground, for it is beautifully adapted for *light infantry drill, which I think you ought to lay yourselves out for.* You should teach your men to take advantage of every stone, bush, and tree, to load on their backs, on their bellies, and in every possible position, so as to be able to inflict loss on an enemy, without getting shot themselves, for they are too valuable for that. *That is peculiarly the kind of service for which you should prepare yourselves, and which you would be called upon to perform, if ever your services should unfortunately be required. At least, that is my humble opinion.*"

To confine the Volunteer programme to light infantry drill, will perhaps seem too modest in the present rage for big battalions of Volunteers (emphatically objected to by the Iron Duke), and in the midst of their otherwise very laudable ambition, to rival the regulars in battalion evolutions; but it seems probable, that, in the event of invasion, military opinion would restrict the Volunteers to General Eyre's programme. The soldier's perfect drill is only a part of his perfect discipline, which is all-paramount. Undisciplined troops, brought under fire in masses, are always liable to ruinous panics, as has just happened in the present American civil war.

Assuredly it is worthy of the Volunteers to try and appropriate to themselves the "speciality" of being the best sharp-shooters in Europe. The Americans won their independence by sharp-shooting: the Volunteers will certainly help to preserve ours by a similar use of their rifles, as suggested

by General Eyre. Colonel Peard, "Garibaldi's Englishman," has also, in a speech to his friends in Cornwall, given similar advice to the Volunteers, suggesting that they should *guard the passes* by four, sixes, and dozens:—especially good advice, since we shall probably have very different opponents to those who fled before Garibaldi.

It is, however, rather too much to say that "the 150,000 Volunteers have stifled ambition in the breast of foreign rulers." The political state of Europe flagrantly proves the contrary. Not a single act of the drama has been left out "by particular desire" on our part; and it is quite impossible to see anywhere the indications of the intimidation imputed, but quite the reverse. There are those who have eyes, and see not; and there is "an amusing story called 'Eyes and No Eyes;' one person who saw everything, and the other, who made the same tour, saw nothing; but the one who saw was right, for the things he saw were there, and the things which the other man did not see were not the less in existence."* These words are like the words of Solomon: let not the utterance be like that of Cassandra—condemned to disbelief by the doomed infatuation of her hearers! Indeed, they say on the Continent that the volunteer movement was an anachronism. When such a movement took place in the height of our old glorious war, it was a magnificent indication of the national will, that our fathers were ready not only with their money, but also with their bodies, to support our armies in the glorious struggle. But now, say the French officers, your volunteer movement in a time of peace only tends to depreciate the regular forces in the national estimate—to make the people think them useless, too costly, to grudge their expenditure, and therefore to neglect their condition and obstruct their improvement.

May events prove the contrary, for the sake of Old England, whom we must transmit to posterity as she was given to us by our fathers. Woe to us if, on the day of struggle, our Army and Militia be not in the highest state of efficiency—well trained, well equipped, and armed with a weapon in which they may confide, to add new names to the glorious long catalogue now emblazoning their standards.

* Lord Palmerston, in a recent debate, referring to the naval preparations of France—*Times*, July 27, 1861—said, There seems to be somewhat of infatuation in this construction of iron ships. It is more than probable that a 100-pounder Armstrong will smash through any of them; but, if not a 100-pounder, why not make 200-pounders, nay, even 500 or 1000-pounders? which would be far less costly than these ruinous experimental ships, for they are unquestionably only *experimental*. As on land, so on the water, rapidity of motion will decide naval battles; we shall need fast ships and the heaviest ordnance, with the utmost skill in the handling of both.

A similar remark applies to breech-loaders. In the hands of the picked men I have ventured to hope for, they will be most desirable; otherwise, they will only be the means of trebling the waste of ammunition, already prodigious, as shown in a previous page. We can now fire three rounds a minute—more than enough for the great mass of armies in battle. It is obvious, however, that the light cavalry should have breech-loaders, and be trained to act as skirmishers, after the new French method, which I hope to explain in a subsequent paper.